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1. MANAGEMENT

Gas Industry Expansion

Natural Gas Marketed Production in U.S. Crosses 11 Trillion Cu. Ft. *Gas Age 124,* 24 (1959) Oct. 15 (4 pp.)

Marketed production of natural gas in the U.S. totaled 11,030 billion CF in 1958. Consumption totaled 10,761 billion CF, an increase of 5% over 1957. Quantities used by classes of consumers from 1957 were as follows: Residential, 2714 billion CF; commercial, 872 billion CF; industrial fuels, 5359 billion CF; field, 1604 billion CF, and carbon black, 211 billion CF.

Three-Quarter Billion Line Outlay Covering 4900 Miles Ok'd by FPC. *Gas Age 124,* 32 (1959) Oct. 15 (6 pp.)

Federal Power Commission (FPC) authorizations during the year to last June 30 will add nearly 3¼ billion CF to the industry's delivery capacity. The projects, covering some 4900 miles of line, will benefit 140 cities of 25,000 population or more in 25 states. Detailed listing of the approved programs is included.

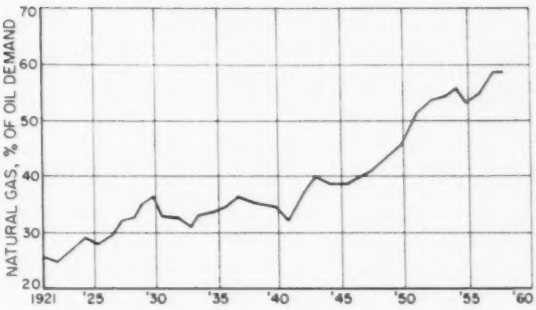
Pipeline Construction Shades a Year Ago. F. H. Love. *Pipeline Eng. 31,* D-19 (1959) Nov. (11 pp.)

Annual survey reveals that the difference in mileage of lines built or underway was 522. Figures are as follows (1959 figures are followed by 1958 figures in each category): Crude oil lines, 3152 vs 4950 miles; products lines, 2781 vs 2677 miles; gas lines, 16,492 vs 14,266 miles; total all pipelines, 22,415 vs 21,893. Figures for planned or proposed pipelines are: Crude oil, 10,601 miles; products, 7034 miles; gas, 17,121; total proposed or planned, 34,756 miles. Detailed tabular breakdown is included.

After Four Years . . . Midwestern Goes Onstream. *Pipeline Eng. 31,* D-42 (1959) Nov. (5 pp.)

Midwestern Gas Transmission Co.'s 350-mile pipeline system was completed in October, initiating new natural gas deliveries into the Chicago area. First winter throughput to three customer distributing companies will approximate 250 MMCF/day, with an increase to 360 MMCF/day by the third winter. South terminus of the 30-in. pipeline is near Portland, Tenn., where Midwestern receives its gas supply from Tennessee Gas Pipeline Co. Construction features of Midwestern's line include: 1) All pipe coated internally; 2) special external coating and wrap applied for high temperatures downstream from compressor stations, and 3) double-jointing on half of system.

Natural Gas Consumption in Terms of Equivalent Oil Demand



(Adapted from *Swift Demand Growth Outside U.S. . . . .* See Abstract, P. 354.)

Gas Industry Management

Drive Starts for Natural Gas Bill. *Petrol. Week 9,* 11 (1959) Oct. 23 (2 pp.)

For the third time in five years, a serious effort is being made to get new natural gas legislation. Type of bill sought is not yet known. Some want a strictly "producer" bill—decontrol with field prices determined by law of supply and demand. Others feel that bill must keep producers' desires in the background while parading as a protege of the city-gate utilities. Broad industry antipathy exists toward repatching old gas legislation. Neither administration or Congress is anxious to draft the bill. Most observers believe that gas men themselves must make the effort. The Administration is expected to stick to its requirement that a gas bill must contain consumer safeguards. Bill must meet two basic political requirements: General support from the industry and protection for the housewife.

Engineering the Profit into Gas Well Production. R. E. Fields. *Petrol Eng.* (Drilling and Producing) *31,* B-19 (1959) Nov. (7 pp.)

Engineering the profit into the operation means planning an installation that will get the most product for the best available price for the least investment and expense. The main points to consider in getting at this problem tie together to lead to the conclusion of what to do and how to do it to get a gas well onstream. These seven points are: 1) sales and legal requirements; 2) basic data and predictions; 3) process comparison and selection; 4) prognosis of work plan; 5) design and sizing; 6) construction and inspection, and 7) training and startup. This list might be thought of as a flow sheet or work pattern. Handling the points in this order is a good step by step approach to getting into production.

Ten Years of Nationalization. H. Parker. *Gas World 150,* 6 (1959) Oct. 3 (11 pp.)

Description of the ten years of nationalization as the modern phase of advance and integration, compared with the earlier history of the 137 years of British gas industry.

Research

PAR Research Hits New Peak. W. F. Morse, Jr. *A.G.A. Monthly 41,* 8 (1959) Oct. (6 pp.)

American Gas Association's PAR (Promotion, Advertising, Research) plan, initiated in 1944, today is sponsored by more than 170 gas utilities and pipeline companies, to carry out activities of nationwide interest to the gas industry. Article is concerned with the research phase. During 1959, there were 65 projects underway to meet the gas industry's needs. Five major research categories are pipeline, gas operations, domestic utilization, industrial and commercial, and air conditioning. A special category includes all projects so basic in nature or so broad in scope that they encompass more than one of the five categories. Summaries of current research projects are presented.

Pipeline Forum Stresses Research. *A.G.A. Monthly 41,* 13 (1959) Oct. (2 pp.)

Report of a forum conducted by the American Gas Association in Dallas, Texas, in September. Topics stressed: Education and research.

Petroleum

Oil in the 60's. Swift Demand Growth Outside U.S. Will Solve Crude-Surplus Problem. *Oil Gas J. 57,* 135 (1959) Nov. 9 (4 pp.)

Predictions for the next decade are: 1) Demand outside U.S. will be at least twice domestic demand by 1975; Western Europe will be the big gainer in the next five years; drilling will continue to increase in this country, at least through 1970, amount of annual increases in drilling will be determined by income from oil and gas less net flow of capital for foreign drilling; average wells will be deeper by about 50 ft/well/yr.

Oil in the 60's. Down-the-line Refining Picture Bright. *Oil Gas J. 57,* 133 (1959) Nov. 9 (2 pp.)

Refining presents a mixed picture today—a boom and a lull. The boom is in Europe and Japan, the lull in the U.S. As a result of these trends, the world refining picture is undergoing some changes. Large-consuming nations are building their own refineries. Location of plants in marketing centers is a post war trend. Large-producing countries are insisting that more manufacturing be situated within their borders.

Drilling

Oil in the 60's. Cost of Drilling Will Drop, Even as Wells Deepen. *Oil Gas J. 57,* 126 (1959) Nov. 9 (6 pp.)

Best-informed drilling men are convinced that costs are too high and they are looking for ways to reduce them. As a result of their work, drilling methods and equipment probably will change more in the next five years than in any 10-year period in the past. There are three possible paths to cut the cost of drilling a well: 1) Speed up drilling rate so that the rig makes more hole per day, per bit and per man; 2) use lower-cost materials in the well itself, and 3) cut the cost of buying the rig, moving it and operating it.

Can the Earth's "Crust" Be Penetrated? D. E. Lambert. *World Oil 149,* 128 (1959) Oct. (4 pp.)

After several months of intensive research, sponsoring groups believe it is entirely feasible to set up a drilling operation in 10,700 ft of water, then drill more than four miles through the earth's crust to the Mantle. Most promising site to date is an area between Guadalupe and Clipperton Islands west of Mexico. Article represents an official report on the "Mohole" Project, and includes ways in which oil industry know-how and equipment can be used, benefits to be obtained and problems to be solved.

Appliances

Predict New Gas Appliance Sales Gains. E. R. Martin. *Appliance Manufacturer 7,* 71 (1959) Oct. (2 pp.)

Manufacturers of gas appliances and equipment anticipate that 1959 unit sales will exceed those of 1958 by 10%. They further anticipate that sales increases will carry through 1960 and that next year's industry sales volume will exceed those of 1959 by an average of 3.8%. These percentage increases will vary from product to product, and the average percentage increase could be as much as 11.7% (1960 over 1959) if individual companies perform up to expectation. New unit peak sales are expected (in 1959) for built-in gas ranges, automatic gas water heaters, gas warm-air furnaces, gas boilers and gas vented recessed wall heaters. Statistical details on all gas appliances and equipment are tabulated.

A New Gas Refrigerator. *Appliance Manufacturer 7,* 60 (1959) Oct. (6 pp.)

Production will be underway around January 1, 1960, on the Norge gas refrigerator, first such appliance to be produced and marketed by the Norge Division of the Borg-Warner Corp. Basic refrigerating system is being produced by Electrolux in Sweden. It is a simple absorption system, proved through years of use.

The Norge Gas Vertical Broiler. *Appliance Manufacturer 7,* 93 (1959) Oct. (3 pp.)

Dual ceramic burners, vertically mounted, are a feature of the new top model ranges manufactured by the Norge Division, Borg-Warner Corp. Their high rate of infrared radiation causes meat to broil much faster. The input range of each of the two burners is from 6000-7500 Btu. Broiler takes 40% less Btu input than conventional types for the task. Other advantages are a cooler kitchen and less work, since the meat does not have to be turned.

Petrochemicals

A New Decade of Progress for the Gulf Coast Petrochemical Industry. C. W. King. *Refining Eng. 31,* C-6 (1959) Nov. (3 pp.)

U.S. petrochemical industry will progress from the expansion phase to the maturity phase of industry development in the 1960's. Industry growth will increase at a decreasing rate through 1965 with total volume production approximately doubling. The basic petrochemical building blocks for chemical conversion, experiencing a phenomenal 18.9% average annual growth rate since 1947, will increase 11.7% in 1959 to 24.5 billion lb with value in the $784 million range. These petrochemical raw materials should reach 41.2 billion lb with value in the $1.2 billion class in 1965. Petrochemical intermediates, growing at an annual 13-14% since 1947, will increase 15.5% in 1959, posting output of 48.8 billion lb accounting for 28% of all chemical production. By 1965, petrochemical products should approximate 85 billion lb valued at over $10 billion, representing 40-50% of total production. Article gives comprehensive prediction of petrochemical growth, including factors, problems, etc., in the next decade.

Petrochemical Growth of C_2, C_3 and C_4 Families. R. S. Ringheim and F. D. Snell. *Refining Eng. 31,* C-9 (1959) Nov. (6 pp.)

Comprehensive report covering the status and important forecasts on the refiner's basic petrochemical building blocks is presented. Ethylene and the C_2 family are the unquestioned kingpin in total product volume. Propylene of the C_3 family now appears to be shifting into a higher annual growth rate than that of ethylene. In the C_4 family, the dominant growth factor is the increasing demand for butane to be isomerized to isobutane and consumed in the alkylation of butylenes (also derived from butane), propylene and pentylene. The reported erratic demand for the various C_4 hydrocarbons would require a detailed study to examine when major requirements of certain firms were changed sharply from year to year.

Foreign Activities

Saharan Pipeline Completed. R. Martin. *World Petrol. 30,* 47 (1959) Oct. (3 pp.)

Hassi Messaoud crude is not moving to the Mediterranean by pipeline yet, but it soon will be. Finishing touches are being put on the 24-in. line across the mountains to the sea and with construction of a terminal for tankers, the crude will move to France at about 80,000 bbl/day early next year.

Canadian Construction Takes a Breather. L. O. Rowland. *Pipeline Eng. 31,* D-51 (1959) Nov. (6 pp.)

With the country now spanned by two gas lines and two crude oil lines, a steady "filling-in" program is expected, but granting of export permits by the National Energy Board could change this. In 1959 more than 1300 miles of natural gas lines were laid, principally in Alberta, Saskatchewan and Quebec. Three new compressor stations were added to the Trans-Canada system in the northern Ontario section.

Cost Accounting

Active-Fields Drilling Report. P. B. Bike. *Oil Gas J. 57,* 133 (1959) Oct. 12 (20 pp.)

In order to analyze the factors responsible for drilling expenses, more than 150 firms were surveyed to obtain the data presented. The drilling programs are representative of average conditions. In some areas core data are shown where available. The over-all costs, rig time distribution, casing and mud programs, and average formation depths are good indicators in evaluating an area. Report includes data on fields in Alaska, Canada, California, Pennsylvania, Louisiana, Mississippi, Arkansas, Kansas, Michigan, Oklahoma, Montana, Nebraska, New Mexico, North and South Dakota, Utah, Wyoming and Texas.

Safety

Chemical Aspects of Fire Extinguishment. A. B. Guise. *Ind. Eng. Chem. 51,* 73A (1959) Nov. (3 pp.)

As a result of fairly recent and not too widely publicized research, understanding of how fire extinguishing agents work has increased greatly. This may lead to more effective provision for the control and extinguishment of fires. The old familiar fire triangle concept is an oversimplification. A new factor, a chemical chain reaction in the flame itself, is a fourth essential. Consequently, in fire extinguishment a new factor has been added: "Interrupt the flame chain reaction." This action may be extremely important as an explanation of the effectiveness of certain extinguishing agents.

2. ENERGY SUPPLY AND ECONOMICS

Gas Reserves

The Present and Future Economy of the Gas Supply. H. Laurien. *Gas-u.—Wasserfach 100,* 85 (1959) Sept. (10 pp. German text.)

Rapid growth of the industry in West Germany since 1950 (production figures have doubled during this decade) is outlined. The competitive situation for all heat energy is discussed for Western Europe from the basis of the OEEC survey of 1957. The influence of increased availability of petroleum in the heat market and in gas manufacture is noted. Natural gas supply, by liquified methane tankship and by pipeline routes, is analyzed from the standpoint of existing European pipeline grids and industrial or domestic demands.

Energy Sources

The Economic Outlook on Coal, Oil and Natural Gas. B. C. Netschert. *Independent Petrol. Assoc. Monthly 30,* 38 (1959) Oct. (3 pp.)

Article summarizes findings of a more comprehensive study covering the period 1850-1975. Of a total energy consumption 88% higher in 1975 than in 1955, gas will double (107%), coal will lose in amount (70%), oil will keep pace with a total of 86%, electricity will increase by 135%, and natural gas liquids will expand by 183%. Natural gas will increase to 28.5% of total energy use. Oil production (1975) will be at the rate of 4 billion bbl primary and 2 billion bbl secondary from 500 billion bbl total which includes 30 billion bbl proved, 200 billion bbl known currently unrecoverable and the remainder yet to be discovered. Gas production will be 22.5 trillion CF in 1975 from an estimated 1200-1500 trillion CF supply. Beyond 1975, technological progress not yet foreseeable will determine the availability of coal, oil and gas, but the peak production of oil and gas would appear to come about somewhere around the year 2000.

Oil Comes In, Coal Piles Up. *Business Week 1575,* 128 (1959) Nov. 7 (3 pp.)

It is already clear that the European coal industry has reached a turning point. Although coal is still Europe's dominant energy fuel, the challenge from oil is so serious that the industry cannot avoid disturbing readjustments. The transition will be more jarring than anything that happened when the U.S. coal industry gave ground to oil. It is aggravated by the worldwide extent of the coal surplus, which reaches from Europe to Japan and the U.S.

Fuel Cells

Fundamentals of Electrode Kinetics as They Apply to Hydrogen-Oxygen Fuel Cells. L. G. Austin. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Much of the detailed knowledge of the kinetics of irreversible electrode processes has been obtained comparatively recently and is not too well known except to specialists in electrochemistry. Paper is an attempt to outline briefly the bases of electrode kinetics and chemisorption as they apply to the catalyzed hydrogen-oxygen type of fuel cell. It covers chemical polarization, concentration polarization, and loss of theoretical potential due to the free energy changes on gaseous chemisorption. A brief discussion is given of the effect of changes of mechanism on the various voltage losses due to polarization.

The High Pressure Hydrogen/Oxygen Fuel Cell. F. T. Bacon. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Evolution of the present design of cell using diffusion electrode of porous sintered nickel is briefly described, and a section deals with the prevention of corrosion of oxygen electrodes. Cell performance is discussed, including separation of the losses into electrolyte resistance and activation polarization at each electrode; reference also is made to the effects of pressure, temperature and electrolyte concentration. A section on the use of other gases shows that the use of pure hydrogen and oxygen is most favorable for this kind of cell and the present multicell design, complete with control gear, is described.

High Temperature Galvanic Fuel Cells. G. H. J. Broers. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Stability of electrolytes for high temperature fuel cells is discussed. Of all electrolytes investigated, only fused carbonates appear to be stable. The development of laboratory model magnesium oxide-carbonate cells and interpretation of their characteristics are described. Performance results with regard to electrode gases and stability are surveyed.

The High Temperature Fuel Cell and the Nature of the Electrode Process. E. Gorin and H. L. Recht. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Experimental data on the performance of the silver, nickel and iron as air and hydrogen electrodes in the high temperature cell are presented. Polarization of the hydrogen and air electrodes is shown to be small at temperatures of 700°-800° C, but the internal resistance of the cell is high. A theoretical discussion is presented of the nature of the electrode process. A mathematical treatment is given for the integra-

tion of cell performance, with the transport process considered either as diffusion through the metal in bulk or by surface diffusion.

The Hydrogen-Oxygen (Air) Fuel Cell with Carbon Electrodes. K. Kordesch. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Carbon electrodes carrying suitable catalysts operate on hydrogen and oxygen at temperatures between 20°-100° C at gas pressures from 0.1-10 atm. with conversion efficiencies around 70%. The cells have an open circuit potential up to 1.13 v in potassium hydroxide electrolyte and produce current densities as high as 200 ma/sq cm above 0.8 v. Continuous and intermittent operations over periods up to two years have been achieved. The oxygen electrode is now limited to alkaline cells; the hydrogen electrode works equally well in acid cells.

Carbonaceous Fuel Cells. H. H. Chambers and A. D. S. Tantram. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Brief review of work at the Sondes Place Research Laboratory (Surrey, England) on high temperature fuel cells is presented. Particular attention is given to the problem of the operation of high temperature fuel cells on carbonaceous fuels.

Catalysis of Fuel Cell Electrode Reactions. R. B. Rozelle and G. J. Young. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Fuel gas cells, several commercial prototypes of which have been developed, are subject to an irreversible free energy process due to chemisorption of the reactant gases. The electrode reactions established are between the chemisorbed gases and the electrolyte and hence the potential developed by the cell depends on the energy state of the chemisorbed species. Thus, the electrode catalyst can play a dual role in fuel gas cell reactions—it can enhance the rate of reaction if chemical kinetics are the controlling factor and it can have a major influence on the open circuit potential and power characteristics of the cell by controlling the free energy loss due to chemisorption. Paper presents experimental data for a variety of catalysts for both the fuel electrode and the oxygen (air) electrode.

The Fuel Cell Drives a Tractor. *Business Week 1572*, 33 (1959) Oct. 17 (2 pp.); **Fuel Cells Power Tractor.** *Pipe Line Ind. 11*, 52 (1959) Nov. (2 pp.)

Allis-Chalmers Mfg. Co., Milwaukee, Wis., recently demonstrated an electric tractor powered by a fuel cell which makes electricity directly from propane gas. It was the first time in the U.S. that a fuel cell has officially been demonstrating powering a full-sized vehicle. Fuel cell used differs from conventional storage batteries in that it converts the energy of chemical fuels that are fed into it directly into electricity. It has few moving parts, requires little maintenance, and is simple in design.

Fuel Cells Could Produce Electrical Power at High Efficiency. J. G. King. *Fuel Efficiency 7*, 14 (1959) Oct. (2 pp.)

Keen interest is evident, both in the U.S. and in the U.K., in fuel cells. At present only in the development stage, these could provide electrical power at high efficiency, making them an economic proposition even in the coming atomic age. A well-known electronics firm in England, working under a N.R.D.C. contract, recently demonstrated some of their work in this field with the Bacon cell.

Solar Energy

Photochemistry in the Solar Furnace. R. J. Marcus and H. C. Wohlers, *Ind. Eng. Chem. 51*, 1335 (1959) Nov. (4 pp.)

Focal spot of the solar furnace can be used as a cool, intense light source. Liquids as well as gases can be handled at the focus of the solar furnace as they absorb only selected wave lengths. For this reason photochemical light absorption can take place at ambient temperature and below. This use of the solar furnace can become important when *in situ* light source is required. The photoreduction of ceric ion in perchloric acid solution was studied as an illustration of such a use. The stoichiometry and kinetics of this reaction remain unchanged in the solar furnace from those observed at room temperature and with artificial light sources.

Nuclear Energy

The Chemical Industry—A Nuclear Future? Part II. Reactor Physics. W. R. Tomlinson, Jr. *Ind. Eng. Chem. 51*, 1339 (1959) Nov. (6 pp.)

Nuclear reactor physics is primarily of concern to the physicist. On the other hand, the potentially attractive use of such reactors to provide space and process heat and for radiation processing, and the chemical nature of fuel processing and the associated chemical production of radioisotopes, impel the chemist toward a modest familiarity with the subject.

Petroleum

Oil Conservation Law and Program to Stop Land Subsidence at Long Beach, California. S. M. Roberts. *Interstate Oil Compact Commission Committee Bull. 1*, 33 (1959) June (7 pp.)

Since the development of Wilmington field in 1936, there has been a total of over 830 million barrels of oil produced, with some 2900 wells now in operation. The city of Long Beach is the largest producer. Thirty-five per cent of total past production has come from city-owned tidelands and some uplands properties. Primary reserves of the field are estimated at 200 million barrels, with an additional 430 million barrels possible through secondary recovery methods. Rough estimates of production possible from the undeveloped field extension range from 800-1300 million barrels. Progress toward solving and remaining factors of the subsidence problem and future plans are discussed.

Petroleum Development

A Report on the Growth of Oil in Africa. R. Buttin. *Petrol Eng. 31,* B-97 (1959) Oct. (6 pp.)

Research work carried out on the African continent from 1950-7 includes: Gravimetric surveys (1.623 crew-months); seismic surveys (2.383 crew-months) and a total of 5,250,000 ft drilled. Exploration activity has been carried out, or at least started, in practically every region. The prospective reserve which would guarantee an annual production of 375-450 million bbl, around 1965, is assumed to be already certain, considering the expansion of the oil fields which are being worked on, and the findings that were made during the last few months.

New Interest Is Developing in Argentina's Oil Basins. C. A. Moore. *World Oil 149,* 155 (1959) Oct. (4 pp.); **Argentine Oil Program . . . Past First Base, Rounding Second.** *Petrol. Week 9,* 56 (1959) Oct. 16 (2 pp.)

During 1958, crude oil production in Argentina was 35,697,187 bbl (97,800 bbl/day). There were 174 flowing and 3525 pumping oil wells by the end of the year. In addition, 775 oil wells were shut in. Considered by areas, the 1958 crude oil yield was as follows: Comodoro Rivadavia, 54%; Mendoza, 27%; Plaza Huincul, 15%, and Salta, 4%.

Petroleum Production

"Big Oil" Found in Libya. *World Petrol. 30,* 58 (1959) Oct.

Libya has been catapulted in the front ranks of oil companies almost overnight by the Zelten discovery by Esso Standard (Libya). Cautious preliminary estimates put Zelten's reserves at about 10 billion bbl and its areal extent at 150,000-200,000 acres, with about 50,000 bbl reserve per acre (Jersey officials privately estimate it at more, about 100,000 bbl per acre). That makes Zelten "big oil", rivaling Aramco's mammoth Ghawar field in Saudi Arabia, the world's largest.

Petroleum Reserves

South Michigan's Oil Bonanza. G. D. Ellis and R. E. Ives. *World Oil 149,* 136 (1959) Oct. (5 pp.)

Efforts to prove up a Trenton-Black River trend have transformed south-central Michigan into one of the most active oil plays east of the Mississippi. Currently, the Scipio, Pulaski and Albion fields are prorated at 150 bbl/day of oil and/or 200 MCF of gas. This order is issued on the basis of gas-oil ratio tests. Most of the wells are flowing on a plunger lift. The large gas cap present has caused some difficulty in completing the wells properly. Operators have adjusted to this in the Scipio and Pulaski fields where most of the wells are being completed with gas-oil ratios of less than 600 CF/bbl oil. However, considerable difficulty has been encountered in the Albion field. Excess gas-oil ratios have made it necessary to prorate several of the wells to less than 50 bbl/day oil.

Ten Years of Red China Oil. G. Rosu. *World Petrol. 30,* 94 (1959) Nov. (6 pp.)

China's sedimentary basin, nearly one million sq miles, covers 28% of the country's area. Of this, some 12% has been prospected so that by now 14 out of the 33 large oil-bearing zones are known. Proven reserves are 200 million tons which, at the current production rate, represent a 40-year supply. Possible reserves have risen from 262 million tons in 1949 to many billion tons. A new oil policy adopted in March 1958, aimed at speeding up production, is threefold: 1) Simultaneous development, with national funds, of large oilfields and modern processing plants alongside more primitive communal developments; 2) erection of national and communal synthetic oil plants, and 3) nationwide search for new reserves of oil, shale and coal to feed local plants. Results are that in 1959, crude production will be close to 4 million tons (80,000 bbl/day) or 75% over the 1958 level, and 2.7 times higher than in 1957.

Electricity

A Power Source for Space Flight. *Business Week 1575,* 107 (1959) Nov. 9 (3 pp.)

Important contribution to magnetohydrodynamic power generation (MHD) has been the successful harnessing of long-known principles. In an ordinary electric generator a conductor is moved sideways across a magnetic field. That causes a current to flow in the conductor. MHD depends on the fact that gas, also, can be a conductor, if it is ionized. In the device described a magnetic field is set up across a quartz tube. Air, hot enough to stay ionized, is sent through the tube. An electron flow is set up in the gas at right angles to its motion. Electrodes

on opposite sides of the tube pick off the current. It is estimated by one company that in a short while it will have devices that will convert 40-50% of thermal energy into electricity using this method; later versions may achieve up to 80% efficiency. This compares with a typical 35% conversion rate for present turbo generators.

Space Heating

Evaluating Hot Environments. R. F. Scherberger. *Air Conditioning, Heating and Ventilating 56,* 71 (1959) Nov. (3 pp.)

Body maintains thermal equilibrium primarily by mechanisms of regulating its rate of heat loss. In environments which are termed comfortable, approximately 60% of the metabolic heat is lost by radiation; the remaining by evaporation and convection. Other minor modes of heat transfer, as for example via the respired air, etc., normally have little effect on the over-all heat balance of the body.

Radiant Heat

The Physics of Radiant Heat. J. J. Ruddick. *Air Conditioning, Heating and Ventilating 56,* 68 (1959) Nov. (2 pp.)

Wave length of maximum energy emission is established by Wien's Displacement Law which states that the wave length of maximum energy emission multiplied by the absolute temperature of the radiating body is a constant. The amount of such energy received and taken up by objects in the vicinity of heated radiating bodies depends on the size, temperature and character of the radiating body; and the distance and size of the receiver, the absolute temperature of its surface, and the absorptive characteristics of its surface.

Solar Energy

Large Area Solar Energy Converter and Method for Making the Same. M. E. Paradise (assigned to Hoffman Electronics Corp.) U.S. 2,904,613 (1959) Sept. 15.

Process for producing a photoelectric converter which includes the steps of pulverizing semiconductor materials of a first type, treating the surface of each particle of such pulverized material with an impurity to produce a surface layer of semiconductor materials of the opposite type, providing upon a supporting surface a layer including such treated pulverized material and an electrically insulating binder interposed between respective particles, etching away said surface layer of said particles to leave exposed regions of said first type, and interconnecting said regions of said first type and said regions of said opposite type, respectively.

Radiant Energy Converter. N. J. Regnier (assigned to Hoffman Electronics Corp.) U.S. 2,904,612 (1959) Sept. 15.

Radiant energy converter is claimed which consists of a planar base member supporting a number of converter cells with sensitive faces pointed toward the source of radiation. Improved utilization of the supporting surface is achieved by surrounding each cell face with a frusto-conical reflecting element with the surface at such an angle as to direct the radiation onto the cell face. Reflector surfaces of adjacent surrounding cells are joined because of their slope, to direct all the received radiation to the sensitive cells.

Tar Sands

Bituminous Sand Process. P. W. Fischer, V. Kenny and J. W. Scheffel (assigned to Union Oil Co.) U.S. 2,903,407 (1959) Sept. 8.

Granulated bituminous sand, stored under water to avoid evaporation loss of its natural moisture, is passed to an inclined cylindrical mixer in which the solids are tumbled with a dilute (0.5-20 lb/bbl) solution of 30% sodium silicate mixed with a 0.1-2.5 bbl of nonvolatile hydrocarbon solvent, until reduced to a pulp. This pulp then is settled in a separator zone at 160-250° F by passing downward over baffles, while the oil content is freed from particles to form a surface layer. The aqueous phase may be recycled to mixer or storage zone.

Method of Recovering Bitumen. H. Hennig (assigned to The Pure Oil Co.) U.S. 2,906,337 (1959) Sept. 29.

Process of recovery of petroleum from solid tar sand deposits is claimed in which a pattern of closely spaced wells are drilled down to the deposit. Connections to a selected producer well are made by usual methods to form a five-spot pattern. Then gas or steam at 400-650° F and 200-1000 psig is forced down outer injection wells to liquefy and drive bitumen to the outlet well until the whole thickness of formation is treated. Then the partly denuded sand is stripped with hot gas at 900-1000° F at high velocity and the bulk of the oil is recovered from the producing well stream. Finally the partly cooked residue in the formation is burned by arc injection to complete the oil removal and waste heat from this and is recovered to generate steam and stripper gas for earlier stages.

Tar Sand Distillation Process and Apparatus. C. H. O. Berg (assigned to Union Oil Co.) U.S. 2,905,595 (1959) Sept. 22.

Bituminous solids (tar sands) are treated to improve yields of oil in an apparatus comprising a combustion furnace in which the hot spent carbon bearing

solids from the oil eduction kiln are burned with air in a fluid bed, inclined baffle bed, or a moving shallow bed to give coke-free sand at 1000°-2500° F, which is recycled to provide eduction heat for raw sand feed, and also hot combustion gases which are used as stripping gas to sweep oil vapors from the kiln.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

Deep Drilling Lessons from Pecos County. H. W. Patterson. *Drilling 20,* 58 (1959) Oct. (4 pp.)

Problems encountered are not the same in all areas. Usually the high temperature, heavy mud weight, abnormal pressure problems have been the limiting factors in Gulf Coast operations. In Pecos County Phillips experienced bottom hole temperatures as high as 472° at 23,400 ft in the Montgomery "A" No. 1 well but maximum temperature experienced at total depth in the "EE" No. 1 was calculated to be 355°. Experience shows that the casing program is perhaps of first importance. Two or three intermediate strings may be necessary and these must be designed to permit the best possible drilling situation in the section of open hole next to be drilled.

Relating Slim-Hole Drilling Performance to South Louisiana Drilling Problems. J. N. Pedersen. *J. Petrol. Tech. 11,* 17 (1959) Oct. (4 pp.)

Slimhole drilling has been applied successfully in world-wide exploratory as well as in development drilling, and many published articles have pointed to the savings. Until the present, however, very little slimhole drilling has been attempted in South Louisiana principally because of the deep drilling depths and the complex hole problems encountered. These mean higher costs which may make certain exploratory drilling prospects unattractive or may preclude further development of oil or gas discoveries. Article recounts some of the advantages of slimhole drilling and suggests how proper techniques could appreciably reduce costs in South Louisiana.

Why Does Drill Pipe Fail in the Slip Area? W. B. Reinhold and W. H. Spiri. *World Oil 149,* 100 (1959) Oct. (6 pp.)

Following are some conclusions that have been drawn about drill pipe failures along with some theoretical calculations: Drill pipe failures in the slip area are caused by 1) highly concentrated stresses and 2) improper handling; these failures can be prevented by maintaining rotary master bushings and slips to correct API specifications and by good handling techniques; transverse loading varies inversely with the coefficient of friction between the contact area of the slips and faster bushings—therefore, a dry condition between slips and master bushings should be maintained; maximum axial and transverse loads do not act at the same cross section in the slip area . . . therefore, the calculated axial load versus the transverse load factor must always be considered when designing a drilling string where excessive hook loads are expected; oil and gas wells can be drilled successfully with 4½-in., 16.6 lb/ft, Grade E drill pipe approach hook loads greater than 250,000 lb, provided rotary slips and master bushings are maintained to API specifications and good handling techniques are used.

Drilling Muds

How to Get the Most Out of Your Surface Mud System. E. McGhee. *Oil Gas J. 57,* 107 (1959) Oct. 12 (16 pp.)

Some of the things both contractor and operator must watch in order to have a good surface mud system include: substructure, tanks and shaker of proper height so that return mud will flow by gravity; properly functioning shale shaker; utilization of steel tanks when necessary; application of mud-mixing pump, motor-driven mixers and agitators if conditions permit; utilization of a desander, and storage and handling of mud materials without excess waste.

New Developments in High Temperature Drilling Fluids. J. C. Cowan. *World Oil 149,* 116 (1959) Oct. (5 pp.); *Oil Gas J. 57,* 83 (1959) Nov. 2 (5 pp.)

Environmental alterations can result in an undesirable increase in rheological and filter loss properties, thus increasing the difficulties of deep hole drilling. Stuck pipe or casing, poor logging tool runs, blowouts due to swabbing, fishing expenses and downtime to condition mud may be expected. To overcome these limitations, new and old drilling fluid additives have been tested for use at well temperatures of 300-450° F. Performance evaluations of these formulations require special procedures and testing equipment.

Exploration

"Specialists in the Unusual" Spark Pennsylvania Program. *Drilling 20,* 78 (1959) Oct. (2 pp.)

Fox and Son pool cable tool and rotary techniques for a significant probe of Green County's (Pa.) 8000-ft possibilities. Their present assignment is evaluation of the Oriskany Sand possibilities underlying a 24,000-acre block in Greene County. Most

of the 5000-ft-and-deeper rights in the block were assigned to a Pittsburgh wildcatter. One of three joint operators is J. A. Fox & Son, Inc.

Geology

How to Evaluate Cuttings in Air and Gas Drilling. H. F. Downs. *World Oil 149,* 162 (1959) Oct. (3 pp.)

Determination and evaluation of oil and gas shows and sample description comprise wellsite geologists' primary functions. Various techniques for show evaluation and sample running used in conventional fluid rotary drilling have been modified somewhat by the use of air and gas as a circulating media.

Offshore Operations

How to Drill and Complete Wells on the Ocean Floor. D. Guinn. *World Oil 149,* 108 (1959) Oct. (8 pp.)

During the past four years, approximately 500 wells have been drilled at sea in water depths to 400 ft. Many of these holes were bottomed below 6500 ft and some below 11,000 ft. Methods of drilling from a floating vessel vary as to the type and area of operation and the amount of drilling and pressure control desired. Tools used in subsea drilling are not new, but standard tools that have been adapted to subsea techniques. Since these tools are used on the ocean floor, they require some type of remote operation. Desirable factors in the subsea drilling method are: Increased flexibility with water depth; pressure control equipment in a position of minimum motion; well control maintained even during rough seas; completion of wells on the ocean floor or on the surface; low equipment cost per well, and location preparation not necessary. Article discusses some of the basic operational techniques which have developed during several years of subsea drilling.

Offshore Compressor Platforms. Z. Fekete. *Oil Gas J. 57,* 141 (1959) Nov. 9 (6 pp.)

Article includes a discussion of several factors which must be considered in the design of any compressor installation to be built in water, accessible only by water or air transportation. These points include: 1) Factors governing the foundation; 2) type of installation, or nature of marine environment; 3) construction planning, including equipment specifications; 4) actual construction, and 5) costs for foundations and compressor stations.

Permeability

How to Determine Effective Permeability. E. T. Guerrero and F. M. Stewart. *Oil Gas J. 57,* 87 (1959) Oct. 26 (2 pp.)

Problem in finding permeability and static pressure from multiphase buildup data is solved and discussed. Equations of Miller, Dyes and Hutchinson, modified by Perrine, are used.

Reservoir Engineering

Correlation of k_g/k_o Data with Sandstone Core Characteristics. M. Felsenthal. *J. Petrol. Tech. 11,* (T.P. 8084) 258 (1959) Oct. (4 pp.)

Engineers frequently are faced with the problem of having to predict oil recovery from a solution gas drive reservoir in the early life of a field. This is often the time when actual laboratory or field-derived gas-oil permeability (k_g/k_o) data are not yet available. Although excellent collections of k_g/k_o data for various types of rocks may be found in the literature, a need exists for a more detailed correlation of these data with core properties such as porosity, permeability, clay content or pore size distribution. Article presents this type of correlation for sandstone material. It is based on laboratory tests performed on over 300 core samples from 19 reservoirs in the U.S. and Canada.

Development and Evaluation of Gas-Condensate Reservoirs. Part 6. W. C. Goodson. *Petrol. Eng.* (Drilling and Producing) *31,* B-52 (1959) Nov. (4 pp.)

In this study an individual company operation and ownership of the entire field is the basic premise; but in most operations the need for unit considerations is generally a necessity. In this discussion no detailed economics or cost comparisons will be made. Only an outline of the main factors affecting unitization economics will be given. Unitization is practically a must for multioperator secondary recovery projects and is becoming increasingly useful as a means to avoid excessive drilling and cut operation costs even when secondary recovery is not a prime consideration.

Development of Charts for Calculating Bottom-Hole Pressures from Surface Measurements. P. B. Crawford. *Petrol. Eng.* (Drilling and Producing) *31,* B-82 (1959) Nov. (6 pp.)

This is a resume of Texas A & M Bulletin 72 of July 1959. A series of some 136 charts has been developed for facilitating the calculation of static and flowing bottom-hole pressures of gas wells from surface measurements. The detailed procedure is described for constructing the charts, and a few sample charts are presented. In order to use the charts, the surface pressure, specific gravity of the gas at the wellhead, flow rate, wellhead temperature, flow string size, well depth and thermal gradient should be known. The charts for calculating flowing bottom-

hole pressures are designed for wells as deep as 15,000 ft and for pressures as great as 6000 psia.

Effect of Fractional Wettability on Multiphase Flow through Porous Media. I. Fatt and W. A. Klikoff, Jr. *J. Petrol. Tech. 11,* (T.N. 2043) 71 (1959) Oct. (6 pp.)

Concept of fractional wettability is examined. Fractional water wettability of a reservoir rock is defined as the fraction of the internal surface area that is in contact with water. Capillary pressure and relative permeability of unconsolidated sand are shown to be functions of fractional wettability.

Properties of Petroleum Reservoir Fluids. E. J. Burcik. (New York: John Wiley & Sons, Inc., 1957) 190 pp; $7.50.

Author presents the basic physical properties of natural gases and dissolved gas systems in a manner and detail adequate for all but the most precise calculations. The qualitative phase behavior section is particularly well presented, but the material in the quantitative section should be used only for first approximations of phase behavior in naturally occurring systems. The final chapter on applications of reservoir fluid characteristics concisely encompasses a broad range. The book should prove especially useful as an introductory text or for self-study, with the many examples which serve as an important asset to the presentation.

Simplified Equations of Flow in Gas Drive Reservoirs and the Theoretical Foundation of Multiphase Pressure Buildup Analyses. J. C. Martin. *J. Petrol. Tech. 11,* (T.P. 8091) 321 (1959) Oct. (3 pp.)

Simplified equations are developed for the flow of fluids in gas drive reservoirs in which the effects of gravity can be neglected. Results show that the pressure distribution is governed by a nonlinear heat flow type of equation, and the saturation of distributions are related to the pressure by the same equations as those developed by Muskat for the average pressure and saturation in gas drive reservoirs. Development presented constitutes a theoretical justification for Perrine's method of pressure buildup analysis.

Secondary Recovery

A Summary of Unitization and the Engineering Functions in Unitization. B. A. Landis, Jr. *J. Petrol. Tech. 11,* 30 (1959) Oct. (3 pp.)

Article 1) summarizes the over-all picture of unitization and 2) reviews the specific function of the petroleum engineer in the formation of fieldwise producing units involving secondary recovery operations.

Well Practice

Foaming Agents: Cure for Water-Logged Gas Wells. H. N. Dunning, J. L. Eakin, W. N. Reinhardt and C. J. Walker. *Petrol. Eng.* (Drilling and Producing) *31,* B-28 (1959) Nov. (6 pp.)

New method for removing water from well bores, by the use of foaming agents, was described recently (see *Gas Abstracts 15,* 38). The method is rapid and inexpensive, averaging about $5/well treatment. Furthermore, only a lubricator or small pump is required for the treatment. Foaming agents form a light foam column when properly mixed with the water or brine in the well bore and agitated by even a small amount of gas from the formation. This lightened column then is lifted from the well by gas pressures too low to lift a column of water. Furthermore, the foam is quite rigid and, by capturing the gas, serves to prevent it from bypassing water in large casings.

Free Piston Removes Accumulated Liquid from Gas Wells. C. M. Beeson and D. G. Knox. **Part 1.** *Oil Gas J. 57,* 138 (1959) Oct. 19 (5 pp.); **Part 2.** *Ibid.,* 93 (1959) Oct. 26 (4 pp.)

Recent and fast-growing application of free pistons is being made in gas wells for removing liquid accumulations which hold back gas production and may kill the well. It has been found that gas production is substantially increased by the automatic removal of even very small volumes of water or condensates per day. Gas-lift plungers also keep the tubing free of paraffin. Installation is low-cost and requires little attention. Technique provides for less back pressure on the formation and prevents certain wells from making sand.

Here's How to Improve Your Gas Lift Installations. Part 3. Simplified Valve Spacing Chart for Intermittent Gas Lift Design. H. W. Winkler. *World Oil 149,* 159 (1959) Oct. (3 pp.)

New, simplified gas lift valve spacing chart has been developed which allows operators to quickly determine valve spacing in low productivity intermittent wells. Suitable intermittent gas lift valve installations for this type of well can be determined in the field when little or no data are available for more precise calculations.

The Permeator: Pipeline to Greater Oil Recovery. R. W. Coburn. *Oil Gas J. 57,* 100 (1959) Oct. 26 (5 pp.); **Oil Well Pipe Has Built-In Perforations.** *Business Week 1574,* 126 (1959) Oct. 31.

New field-proven method of well completion uses the permeator to provide casing perforations without damaging the cement. When installed in the well, these devices create miniature pipelines from the producing formation to the well bore, eliminating

all contact between well fluids and the cement behind the casing. Method has these advantages: No cement fracturing, casing burrs or "junk" in the hole; cement is protected from acid attack; automatic casing centralization; machined seat for ball sealers; uniform diameter of perforations; ideal application for multitubingless completions.

Secondary Recovery

Method of Treating a Petroleum Producing Formation. G. Herzog (assigned to Texaco, Inc.) U.S. 2,906,340 (1959) Sept. 29.

Method is claimed for treating a petroleum formation which comprises injection into an existing well bore of a petroleum oil which deposits carbon upon thermal cracking, followed by injection of oxygen-containing gas, combustion of the oil and carbon deposit under controlled pressures to drive out water and increase permeability, and then discontinuation of the combustion and producing oil.

Process for Recovery of Petroleum. S. L. Ruskin (assigned to Union Carbide Corp.) U.S. 2,906,680 (1959) Sept. 29.

Process for removing petroleum from petroleum-bearing sands is claimed which comprises irradiating said petroleum-bearing sands with from 100-400 million Roentgens and recovering the irradiated petroleum released from said sands.

4. GAS CONDITIONING AND LPG RECOVERY

Automation

Automatic Plant for Regeneration of Ethanoline Solutions. B. K. Khromov. *Gazovaya Prom. 9,* (1959) 46 (3 pp. Russian text.)

Conversion of a batch plant for regeneration of spent ethanolamine solutions by vacuum distillation to an automatic plant which continuously returns the regenerated solution to the purification plant is described. Advantages are: Reduction of equipment needed, reduction in ground area requirements, reduction in labor requirements and increased capacity (almost double). Typical operating data are given.

J. W. Penney

Carbon Dioxide

A Partition Cell for the Study of Gas-Liquid Equilibria under Pressure. D. G. Miller. *J. App. Chem. 9,* 531 (1959) Oct. (4 pp.)

Simplified partition cell has been developed for the investigation of gas-liquid equilibria. In it, the two phases may be brought to equilibrium fairly rapidly, isolated and then sampled separately. The cell gives results comparable with those already published by other workers. Results for the absorption of CO_2 in water at 30° and pressures up to 300 psig are given.

Hydrogen Sulfide

Equilibria, at Moderate Pressures, in the System CO_2, H_2S, N_2-Sodium Carbonate, Soduim Bicarbonate, Sodium Hydrosulphide and Water. F. H. Garner, R. Long and D. G. Miller. *J. Appl. Chem. 9,* 534 (1959) Oct. (9 pp.)

Equilibria between CO_2 and sodium carbonate solutions have been studied at moderate pressures by means of a partition cell, and using chemical methods of analysis. In the case of the absorption of CO_2 alone, total conversion of the carbonate to bicarbonate takes place and in addition considerable amounts of 'free' CO_2 are found in solution. The equilibria involving CO_2 and H_2S have been studied at 20 atm pressure and at temperatures from 30°-60°, using nitrogen as an inert gas. The amounts of 'free' CO_2 and H_2S in solution, calculated using published data on the chemical equilibrium, decrease with increase in temperature and solution concentration. The influence of 'free' molecular species on absorption is briefly discussed.

Reaction Rate Constants by Radioactive Tracer Techniques. D. M. Himmelblau and A. L. Babb. *Ind. Eng. Chem. 51,* 1403 (1959) Nov. (6 pp.)

Reaction rate data are important both in evaluating processes for carbonation of aqueous sodium carbonate-bicarbonate-sulfide solutions and in the study of chemical absorption phenomena. With a radioactive tracer technique reaction rate constants for the system were measured without the influence of diffusion effects. Principal reactions for the hydrogen sulfide-sodium bisulfide-water system were investigated, and a mathematical procedure for evaluating rate constants was developed. The results of these studies indicate that carbon dioxide system reactions proceed independently of hydrogen sulfide system reactions.

Hydrogen Sulfide Removal

Today's Petrochemical Methods for Sulfur Recovery. P. W. Sherwood. *World Petrol. 30,* 100 (1959) Nov. (5 pp.)

At present there are 58 USA companies engaged in the recovery of sulfur from sour gases with plants ranging in size upward of 10 ton/day. Probably the world's largest single sulfur recovery unit is British American Oil Co.'s Pincher Creek plant near Cal-

gary, Alberta (Canada), with a rated daily capacity of 750 long tons sulfur. Several factors have been responsible for the rapid expansion in sulfur recovery from sour gases. On the purely economic side, the principal incentive came from the rise in the price of sulfur which rose from $16-18 during the early 1940's to a high of $31/long ton in the first part of 1956. Therefore sour hydrocarbon gases are an attractive economic source in most locations. Conversion of hydrogen sulfide to elemental sulfur—a major step in the process—is described.

Tower Purifiers at Beckton. *Gas J. 300,* 148 (1959) Oct. 21 (2 pp.)

Description of the new Balfour-Lecocq tower box purifier plant at Beckton works of the North Thames Gas Board. Plant consists of 15 towers each holding 16 trays with a total capacity of 30 MMCF/day of coal gas. Unpurified gas from the horizontal retort houses is brought in by a 48-in. main and is divided into three streams, in each of which are five towers. After purification the streams join at a common outlet and the gas passes to the holders through a 48-in. steel main. Each of the 16 trays in a tower carries a charge of 25-30 tons of bog ore/oxide mixture, making the total charge per tower of over 400 tons, and more than 2000 tons per stream.

5. NATURAL GAS TRANSMISSION

Automation

Automation in the Pipe Line Industry. Introduction. F. V. Long. *Pipe Line News 31,* 41 (1959) Oct. (16 pp.)

Two entirely different techniques are available for operation of an automatic pipeline — the use of self-contained computing or load control equipment at the station site and the use of a computer at the central point to take care of the individual engines, motors and valves to perform a certain desired function. Design of an automatic line must be a joint operation of all concerned. Survey is presented in the form of a symposium and is divided into four parts: 1) Internal control of an automatic compressor station; 2) optimum compressor station operation philosophy; 3) sales and purchase metering, and 4) communication and telecontrol channels.

Compressor Stations

How El Paso Natural Operates and Maintains Three Types of Cooling Systems at Horizontal Reciprocating, Vertical Reciprocating and Gas-Turbine Centrifugal Stations. M. J. Crowley. *Oil Gas J. 57,* 182 (1959) Oct. 12 (3 pp.)

Cooling systems of El Paso Natural's three types of compressor stations differ enough to create different problems and necessitate the use of procedures which are peculiar to each type of plant. Each type is discussed from functional and maintenance viewpoints.

Fluid Flow

Calculation for the Through-Put Capacity of a Pipe Line with Gas Flowing through at Great Speeds. V. V. Smyslov. *New Items in Constructional Technics,* 137 No. 9, Kiev, 1956 (6 pp., Russian text); *Ref. Zh. Mekh.,* (1958) No. 4 (Rev. 3964). (From *Appl. Mech. Rev. 12,* 730 (1959) Oct.)

Based on the equations of the motion of gas in a cylindrical tube, formulas are obtained for the calculation for the throughput capacity of a long pipeline at its outlet to the air. Author shows that the calculations for the throughput capacity of a pipeline, when computed by the earlier accepted formula for the critical discharge from an orifice, even when introducing the coefficient which takes into account the losses along the pipeline, gives results markedly differing from the precise values.

I. S. Simonov

Courtesy Referativyni Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Equation for the Movement of Low Pressure Gas in Pipe Lines. E. K. Odel'skii. *Sb. Nauch. Trudi Belorussk, Politekhn. In-ta,* (1957) No. 56 (10 pp. Russian text); *Ref. Zh. Mekh.,* (1958) No. 4 (Rev. 3962). (From *Appl. Mech. Rev. 12,* 703 (1959) Oct.)

Empirical formula is presented for the determination of pressure loss in low-pressure gas during its passage through pipelines $\Delta p = 17 \times 10^5 (V^{1.75}/D^{4.75}) \gamma l$ where Δp is the fall of pressure, V the hourly consumption of gas, γ the specific weight of the gas, D the diameter of the pipeline, l the length of the pipeline. Tables have been prepared for the determination of pressure loss due to friction, worked out per running meter of length when $\gamma = 1$. An example of the calculations is given.

V. D. Sokolov

Courtesy Referativyni Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

A Mathematical Study of Two-Phase Flow in Well-Flowlines. Part 1. B. T. Yocum. *Petrol. Eng.* (Drilling and Producing) *31,* B-40 (1959) Nov. (6 pp.)

Lockhart and Martinelli correlated two-phase flow in pipes by treating the pressure drops in the oil and gas phases independently. It was attempted to apply their correlation without success. Their work was concentrated on small diameter lines of 1-3 in.

Problems arising in large diameter lines 6 in. and above are quite different. Approach described is different in that it attempts to correlate two-phase flow using dimensionless flow numbers like Reynolds Number, Froude Number, etc., and relies heavily on thermodynamics.

Pipeline Construction

Katy Railroad's Plans Jell for Pipeline Service in Midwest. *Butane-Propane News 21,* 50 (1959) Nov. (2 pp.); **Odds Better for Katy's Latest Line.** *Petrol. Week 9,* 120 (1959) Nov. 6 (2 pp.)

It is expected that plans to pipe LPG along "Katy" railroad rights of way from Texas to Iowa, Illinois, Minnesota and Wisconsin will be complete by fall of 1960. The 30,000 BD line will be constructed of X42 seamless or electric weld pipe, with wall thicknesses varying from 0.188-0.250 in. It will be of 8-in. diam as far north as Pampa, Texas; 10-in. from Pampa to McPherson, Kans.; 8-in. from McPherson to Lincoln, Neb., and Moberly, Mo.; and 6-in. from there on north. Salt storage at McPherson can be had for $2/bbl. Recovered over a 20-year period, this reduces to $0.10/bbl/yr for one turnover, or 0.25 cents/gal. To this should be added about 0.01 cents for dehydration costs. Rock storage, it is estimated, costs about $5/bbl, or nearly 0.75 cents/gal for one turnover. Steel storage costs 3 cents on the same turnover.

Spanning the Narrows. M. Anuskiewicz, Jr. *Gas 35,* 114 (1959) Nov. (4 pp.)

In spanning The Narrows of New York Harbor with a dual line, the Brooklyn Union Gas Co. has installed an outstanding underwater pipeline crossing. In all four lines have been pulled across the water in a common trench — two 24-in. natural gas mains by Brooklyn Union and two 24-in. oil products lines by Narrows Crossing Inc. Together with the 8-mile 30-in. Clove Lakes line across Staten Island, the new installation provides the first major connection between the New York Metropolitan area and the Texas Eastern Transmission Corp. pipeline system. A capacity of up to 400 MMCF/day is planned.

How Transcontinental Installs Offshore Pipelines. I. W. Dods. *Pipeline Eng. 31,* D-38 (1959) Nov. (3 pp.)

This year Transcontinental Gas Pipe Line Corp. has added 86 miles to its offshore gathering lateral system. Of this total, 59 miles was in the Eugene Island area, 15 miles in the Vermilion area and 11 miles in the High Island area. Transco's total mileage of offshore lines is 135 miles. Most of the lines are 16-in., although 15 miles of 14-in. were laid this year and approximately 5 miles of 10-in. This phase of pipelining necessarily differs from the laying of land lines and has its own techniques, but there are many problems yet to be solved. Author suggests some of the solutions.

Pipeline Operations

Rubber Balls Take on New Pipe Line Jobs. M. L. Barrett, Jr. *Pipe Line Ind. 11,* 31 (1959) Oct. (9 pp.)

Removal of liquids from offshore gas gathering lines, filling and purging new lines after construction, "automatic" liquid meter proving and special cleaning tasks are some of the more interesting ones.

Pipeline Systems

Expanded System Faces Winter's Test. *Petrol. Week 8,* 52 (1959) Oct. 23 (2 pp.)

Transcontinental Gas Pipe Line Corp.'s new transmission and storage facilities, all of which will be in operation by the end of this month, will boost gas shipments to its northeastern markets this winter to a record high. Transco's new transmission facilities will increase the capacity of its system by 187 MMCF/day to 1,296,000,000 CF/day by about December 1.

Piping

First Commercial Use of X-56 Pipe. N. F. Blundell. *Oil Gas J. 57,* 106 (1959) Oct. 19 (2 pp.); **Welding Technique for X-56 Pipe.** *Petrol. Eng. 31,* D-30 (1959) Oct. (3 pp.)

During the summer and fall of 1959, Gulf Interstate Co. constructed 350 miles of 30-in. diam high-pressure gas pipeline. Steel used in this line pipe was a new specification for the gas industry in that it had a 56,000 psi minimum yield. As the pipe was of high-carbon steel it approached the upper limits of weldability. Line was proof tested to 110% of working pressure, or 1108 psig, before it was put into service. The test was successful; not one failure of either pipe or weld was found. Since the test was conducted the line has been operating successfully for four months.

Telemetering

Quigley Station: A Pacific Lighting System Approach to Remote Control. Southern California's Facilities. D. C. Anderson. *Gas 35,* 57 (1959) Nov. (2 pp.)

Quigley station is a combined metering and regulating station at the Los Angeles terminus of the 30-in. OD pipeline extending from Needles at the California-Arizona border through the Mojave desert and Antelope valley to the Los Angeles metropolitan

area. It was designed and built in 1957 to measure, clean and control gas received from two pipelines before delivering it to two 30-in. pipelines leading on into Los Angeles and connecting with the 30-in. Texas pipeline system supplied through Blythe, Calif. Current design capacity of the station is 23 MMCF/hr peak and 4 MMCH/hr minimum. Maximum throughput from the Needles Pipeline to date has been about 400 MMCF/day. Over-all design of Quigley station provides for measurement and control of a third pipeline through the station. All piping and most control valves are buried. Vaults are provided for access to orifice meter fittings and to some of the control valves. The balance of the buried valves have extension shafts to place the actuators aboveground.

Quigley Station: A Pacific Lighting System Approach to Remote Control. PLGS Facilities at Quigley. H. L. Clark. *Gas 35,* 103 (1959) Nov. (9 pp.)

Pacific Lighting Gas Supply Co.'s facilities at Quigley measure and control gas into and out of a 34-in., 750-psig natural gas pipeline. It extends from Quigley, the southern terminus, through the Angeles National Forest and the mountainous terrain of the Tehachapis to the southern section of the San Joaquin valley. Function of the 34-in. line is threefold: 1) It serves as a means of transporting high pressure gas from the San Joaquin valley to the Los Angeles metropolitan area; 2) it is used to help equate the gas supply and the peak hourly loads in the Los Angeles area, and 3) it is designed so that perhaps eventually out-of-state gas from the 30-in. Needles pipeline might be delivered to possible future storage fields in the San Joaquin valley.

What's New in Telemetering. B. C. Joyce. *Pipe Line Ind. 11,* 59 (1959) Nov. (5 pp.)

Use of telemetering has grown impressively in the gas industry, and the need for new techniques is now apparent. Specifically, there is a need for faster speed of response, greater utilization of transmission facilities and the need to share these facilities with control functions. New types of telemetering systems which recently have been made available for use in the gas industry may supply some of the answers. These new systems have been "borrowed" from the aircraft and missile industries. Main advances center around faster speed of response and use of single-case transducers.

Pipeline Operations

Pipe Line Plugger. B. Ver Nooy (assigned to T. D. Williamson, Inc.) U.S. 2,906,295 (1959) Sept. 29.

Pipeline plugging apparatus is claimed in which a plug designed for sealing at its periphery is inserted through a T-fitting or saddled hole bored in line. The plug is carried by two pivoted toggles connected to a vertical plate on a cylindrical guide axially movable along the plugger housing by horizontal sliding motion. The plug, when advanced from the housing fully into the pipeline, is moved laterally by the toggles until the peripheral seal is seated.

6. GAS AND LPG STORAGE

Gas Holders

Gasholders—An Indispensable Unit of the Distribution System. S. Langford. *Gas J.* (Survey of Distribution) 106 (1959) (5 pp.)

To date, the gasholder incorporating a water tank has held the field completely—making an interesting point: Underground brick and masonry tanks were largely superseded by partly and fully overground tanks. Now it seems as though the principle of the underground tank is being revived. Elimination of the heavy water tank and its contents is logical from the standpoint of reduced load upon foundations, etc. Instead of rising and falling lifts of a water-sealed gasholder, the waterless principle embodies a disc (piston) floating upon the gas and enclosed within a "permanent structure" shell. There are now about 60 M.A.N. gasholders in Britain and this type has established itself throughout the world; units of as much as 20 mill CF capacity have been built. Article deals with general design, operation and maintenance features.

Liquefaction

New Combinations of Liquid H_2, Liquid O_2, Fluorine, Ozone Ready for Rockets. R. F. Fremed. *Chem. Eng. 66,* 69 (1959) Nov. 2 (6 pp.)

Techniques of handling transportation and storage of liquid H_2, liquid O_2, fluorine and ozone, for use in rocket fuels were discussed at Ohio State. Article presents resume of discussion.

How to Receive and Unload — Liquified Compressed Gases. F. R. Fetherston. *Chem. Eng. 66,* 83 (1959) Nov. 2 (16 pp.)

Liquefied compressed gases can present some particular handling problems. Report discusses equipment and techniques and problems of special gases such as anhydrous ammonia, liquefied petroleum gas, chlorine, methyl chloride, sulfur dioxide and, broadly, liquefied fluorinated hydrocarbons. Safe handling and unloading of liquefied compressed gases can be accomplished only when their physical and chemical properties are understood, when regulations and

standards governing their handling are complied with fully, and when it is realized that accidents are the result of man-failure.

Underground Storage

Computer Application to a Gas-Storage Aquifer. D. Cornell. *Oil Gas J. 57,* 72 (1959) Nov. 2 (6 pp.)

Frontal advance calculation for displacement of gas and water in gas storage aquifers has been programmed for solution using a digital computer. By this means gas and water saturations and ratios of flow rates of gas and water may be calculated. Advantages of the computer solution are rapidity and accuracy of the computations. Application to an elementary problem in gas storage aquifer fluid mechanics is presented.

Constructing Underground Storage Facilities with Nuclear Explosions. R. H. Carlson. *Petrol. Eng. 31,* D-19 (1959) Oct. (3 pp.)

Although several types of underground storage are being developed, only the construction of caverns in impermeable rock is of interest from the point of view of using nuclear explosives. Total storage capacity of these caverns is at present about 1.5 million bbl. Most of the caverns are used for storage of butane and propane; they range in capacity from some 260,000-25,000 bbl. Another possible application of nuclear explosives in the oil storage field is in the construction of open reservoirs which could be covered with floating steel roofs. Standard Oil Co. of New Jersey has constructed such a reservoir. It has a capacity of about 1 million bbl and was put in operation at a cost of $500,000. Oil is prevented from escaping by regulating the surrounding water table so that its hydrostatic head is always greater than that of the oil. The floating steel roof over the reservoir has an area of 1⅓ acres.

Sun Oil Cuts Overhead with Huge Storage Cavern. *Butane-Propane News 21,* 44 (1959) Nov. (2 pp.)

In 1954, Sun Oil Co. launched investigation of the possibilities for underground storage facilities around its Marcus Hook (Pa.) refinery. After three years of surveys, reports and test borings, the firm decided to dig a cavern under its own refinery. It was decided to use the coring method for the 48-in. diam, 307-ft-long shaft. A 24-ft-long, 4-ft-wide, 1-in.-thick steel cylinder was inserted in a rig that twists it into the earth. After the cylinder bored 24 ft down, a small dynamite charge was set off to break the rock "core" loose at the bottom. The cylinder then was hoisted out, the core removed, and the process repeated. When the shaft was completed, two men began expansion operations of the area at the bottom. The cavern was constructed in a "room and pillar" pattern. On January 7, 1959, after two years of excavating, the first butane was pumped into the cavern through a 8-in. fill line. It is pumped out as needed by two 60-hp pumps, each rated at 70 gal/min.

Methane Liquefaction

Apparatus for Unloading Cold Low Temperature Boiling Liquids from Storage Reservoir. E. H. Brown (assigned to Constock Liquid Methane Corp.) U.S. 2,903,860 (1959) Sept. 15.

Liquefied methane on a tank ship is gasified and unloaded by an improved heat exchange system, in which heat exchanger coils are placed in the cargo tank and the heat transfer medium is circulated through coils (after first passing through gas preheating coils located in the gas phase above the liquid level) from a shipboard heat exchanger and pump unit. The latter exchanger may be supplied with heat (steam, hot water) from shipboard or shore installations.

Process of Liquefying Gases. P. E. Bocquet (assigned to Constock Liquid Methane Corp.) U.S. 2,903,858 (1959) Sept. 15.

Liquefaction of a compressed cooled gas (methane) stream is claimed by 1) passing the stream through a turbo-expander for expansion and partial liquefaction; 2) separating the liquid; 3) passing the gaseous part of the effluent through a second turbo-expander for further liquefaction; 4) reducing the pressure of the liquid of (2) to that of (3), and 5) separating phases of both expander products and mixing for storage.

Storage Tank and Means for Support of Same. J. J. Henry (assigned to Constock International Methane Ltd.) U.S. 2,905,352 (1959) Sept. 22.

Improved tank storage assembly for a ship handling liquefied methane is claimed in which wooden keys are extended downward from the flat bottom wall of the tank in lengthwise alignment with the center of the tank, said keys fitting into hardwood-lined keyways cut in the surface of the insulated floor. Similar additional keys and keyways are arranged lengthwise of the tank and parallel to the above center key, to prevent side movement, but to permit usual contraction and expansion of the tank. Similar keys can be included in the top wall of the tank.

Natural Gasoline Recovery

Treatment of Natural Gas in Distribution Systems. R. L. Hasche (assigned to Carbonic Development Corp.) U.S. 2,909,904 (1959) Oct. 27.

Natural gas at pressures of 400-1000 psig is taken from a transmission line, cooled by heat exchange, condensed, and cooled by adiabatic expansion of

non-condensed gas. The condensate, of ethane and higher, is stored under distribution pressure for peak shaving use, while the expanded non-condensed gas is passed to the distribution line for current non-interruptible use.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

Production of Acetylene by Oxidation Pyrolysis of Methane. V. I. Balita, A. M. Zeliznii, I. M. Romanyuk and V. U. Shevchuk. *Gazovaya Prom. 9,* 36 (1959) (6 pp. Russian text.)

Operating tests were conducted in a specially designed reactor (250 m^3/hr feed gas capacity) for the production of acetylene from methane and oxygen. Reactor included such features as annular reaction tunnel 80 by 30 mm; addition of 5% oxygen requirements to center of hot gas mixture stream, and vanes to increase turbulence of reacting gases. Maximum temperature was 1450° C and reaction time was 0.003 sec. Carbon content of gas was approximately 3 g/m^3 of feed gas. It is estimated that the tunnel burner can be increased to 500 mm which would give a capacity of 8000 m^3/hr of feed gases.

J. W. Penney

Butadiene

Butadiene Production. Commercial Practice with Dow Catalyst. R. J. Harbour. *Petrol. 22,* 348 (1959) Oct. (3 pp.)

Dow catalyst and process for the production of butadiene from selected C_4 feed stocks has undergone several important changes in recent years, as evidenced by the data presented. This process now is employed in ten commercial dehydrogenation units with a nominal capacity of 355,000 tons/yr. A wide range of feedstocks may be employed, and efficient utilization of these stocks at high conversion levels continues to be a prime economic factor dictating more widespread use of the Dow process.

Catalysts

The Role of Hydrogen in Raney Nickel Catalysts. R. J. Kokes and P. H. Emmett. *J. Am. Chem. Soc. 81,* 5032 (1959) Oct. 5 (6 pp.)

Physical properties of two samples of Raney nickel catalysts have been studied. It was found that the hydrogen content was 45-100 cc/g catalyst. Evolution of hydrogen was an exothermic reaction but involved no phase changes and was substantially complete at 400°. X-ray measurements indicated the predominant phase was face-centered-cubic and was presumably an aluminum-nickel alloy containing for one preparation 3% and for the second 8% aluminum by weight. The surface area of these two catalysts was 76 and 63 m^2/g and was not reduced by heat treatment below 250°-300°. Measurements of density and magnetic susceptibility were carried out at room temperature as a function of hydrogen content. These data led to the picture that hydrogen in Raney nickel is present as atoms in a substitutional solid solution.

Coal Chemicals

Coal Acids, an Intermediate for Thermosetting Resins. K. B. Bozer and R. S. Montgomery. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Water-soluble mixture of aromatic polycarboxylic acids obtained from the caustic-oxygen oxidation of bituminous coal has afforded a raw material for an entirely new series of thermosetting resins. Reaction of these coal acids with an alkanolamine, polyhydroxyl compound, or polyamine has given many interesting resins, some with outstanding binder properties. Resins with good tensile strength have been prepared from diethanolamine, various glycols, pentaerythritol, and the alkylene oxide adducts of the coal acids. The chemistry and physical properties of the various resins are discussed.

Coal Gasification

Gasification of Brown Coals from the Kansko-Achinskii Basin. K. V. Malikov. *Gazovaya Prom. 9,* 17 (1959) (2 pp. Russian text.)

Brown coals from the Kansko-Achinskii Basin were gasified in a steam-air blast in large scale laboratory equipment to produce a gas suitable for heating industrial ovens. Coals had a water content of 28-33%; ash 5-15%; carbon 70-75%, and sulfur 0.20-1.4%. Coal size was 10-20 mm. Product gas was 33% CO, 14% H_2, 48% N_2, with a heating value of 1500 kcal/m^3. Air requirement was 1.8m^3/kg of dry coal, and gas yield was 2.9 m^3/kg of dry fuel.

J. W. Penney

Gasification

An Indirect-Cycle Nuclear-Reactor System to Furnish Process Heat. Engineering and Design Concepts. R. C. Dalzell and J. P. McGee. *U.S. Bur. Mines Inf. Circ. 7920.* (Pittsburgh: U.S. Bur. Mines, 1959.)

Nuclear reactor to furnish process heat for coal gasification has been designed, using spherical fuel

elements of a graphite structure impregnated with uranium carbide fuel. Conditions of operation of recycling helium through the reactor and the gasifier are reviewed, with discussion of pressure drop, power for pumping and high temperature turbine. The gasifier would be an alloy tube heat exchanger, operating at 1500°-2500°F. Calculations for a 60 ton/hr coal gasifying commercial system have been based on one 25-thermal-megawatt reactor.

A Mass Spectrometric Study of the Carbon-Carbon Dioxide Reaction. F. J. Vastola and P. L. Walker, Jr. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Reaction of carbon dioxide with carbon was studied in a static system utilizing a mass spectrometer to monitor the partial pressures of all gases present continuously. The rate of reaction of carbon dioxide (and for practical purposes the rate of gasification) was found to be first order with respect to the carbon dioxide pressure. Slightly less than two moles of carbon monoxide were produced for every mole of carbon dioxide that was consumed. This small deviation from a two-to-one ratio was due to the chemisorption of some carbon monoxide. The rate of this chemisorption was a maximum at 600° C. Above this temperature the amount of chemisorbed carbon monoxide rapidly decreased with increasing reaction temperature.

Hydrogasification

Process Analysis of Coal Hydrogasification with Steam and Recycled Hydrogen. C. G. von Fredersdorff. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Thermodynamic analysis was made of a proposed scheme for methane production via coal gasification and hydrogenation with steam and recycled hydrogen to examine potential advantages in thermal requirements and, particularly, hydrogen requirements of this method over other processes under current investigation for producing high-Btu gas from coal. In the proposed method a methane separation step is required to permit recycling of the hydrogen. The analysis disclosed that coal hydrogasification with steam and recycled hydrogen is inoperative without either external heat or external hydrogen. Pressure-temperature conditions can be chosen where, theoretically, the process is autothermic but lacks hydrogen, or is hydrogen self-sufficient but lacks heat. Because thermal requirements can be met by internal combustion of residual carbon with oxygen, it appears that the most advantageous operation would be gained under conditions rendering a self-balance in hydrogen production and consumption.

Production of Natural Gas Substitutes by Continuous Pressure Hydrogenolysis of Petroleum Oils. E. B. Schultz, Jr., N. Mechales and H. R. Linden. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

High-pressure, vapor-phase hydrogasification of petroleum oils in tubular reactors is a method for converting about 90 weight % of the feedstock to 800-1000 Btu/SCF fuel gas consisting essentially of methane, ethane, and unreacted hydrogen; the remainder of the feedstock is converted to low-boiling aromatics, primarily benzene. In a flow system study with 2- and 3-in. ID reactors at 500-1500 psig it was shown that continuous operation without coke laydown in the reactor is feasible at hydrogen feed rates corresponding to the stoichiometric requirements for complete conversion to methane, if the feedstock has a low Conradson carbon residue value. The effects of process variables are illustrated with hydrogasification data for a premium distillate oil, and two-stage operating data for a Venezuelan crude oil. Typical operating results also are presented for feedstocks ranging from kerosine to Bunerk C fuel oil and Boscan crude. The application of these results is illustrated by integral process schemes for the production of natural gas supplements showing material and heat requirements for two methods of hydrogen supply: Catalytic steam reforming of a portion of the product gas, and partial oxidation of recycle oil from catalytic hydrocracking.

Production of Pipeline Gas by High-Pressure Fluid-Bed Hydrogasification of Chars. E. J. Pyrcioch and H. R. Linden. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Direct hydrogenation of coal to methane is a single-step process of potentially high thermal efficiency for the production of natural gas supplements. The feasibility of fluid-bed hydrogasification of non-agglomerating feeds has been demonstrated in a semicontinuous pilot unit with a low temperature bituminous char. Because of its relatively low reactivity, only 25-60 weight % of the moisture-, ash-free char was hydrogasified at the lower feed rates, and 15-35 weight % at the higher feed rates in once-through operation. However, the data indicate that by use of feeds of higher reactivity, deeper beds or multistage operation, gases approaching the desired 900 Btu/SCF level can be produced while maintaining the proper balance between percentage of the feed hydrogasified and the residual char remaining for hydrogen production.

Hydrogenation

Hydrogenation of Coals and Chars to Gaseous Hydrocarbons. R. W. Hiteshue, R. B. Anderson and

S. Friedman. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Bituminous coal, lignite, and anthracite together with a char from low temperature carbonization of bituminous coal were hydrogenated at 800° C and 6000 psig. Highest yields of gaseous hydrocarbons, 94% based on coal, were produced from char and lowest yields, 67%, were obtained from lignite. Hydrocarbon bases contained 82-92% methane, 8-15% ethane, and 1-3% propane. Lignite produced more oil than bituminous coals. Oils boiled below 300° C and contained less than 4% asphaltenes. Although no oils were obtained from char or anthracite, small quantities of coronene were produced from anthracite.

Methanation

Production of Pipeline Gas by Methanation of Synthesis Gas over Raney Nickel Catalysts. H. A. Dirksen and H. R. Linden. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Catalytic methanation of synthesis gas is technically the most advanced process for the conversion of coal to a high heating value fuel gas suitable for supplementing or replacing natural gas. Since only exploratory fluid bed methanation studies have been conducted in the past, an investigation of this processing technique was made. Catalysts were prepared by partial caustic leaching of nickel-aluminum alloys. Results indicate that catalyst conversion capacities of about 2000 lb of methane/lb of original alloy nickel content can be attained under commercially practical fluid-bed operating conditions with 3:1 H_2/CO ratio synthesis gases containing less than 0.01 grain of sulfur/100 SCF. Catalyst loss resulting from attrition, rather than decrease in catalyst activity, appears to be the limiting factor.

Oil Gas

Thermal Cracking of Hydrocarbons by the Koppers Process. P. Schenk. *Erdol u. Kohle 12,* 717 (1959) Sept. (7 pp. German text.)

To meet the increased gas demands of the winter, the Dusseldorf Gasworks began operation of a Koppers plant for producing utility gas from oil at the end of 1956. The plant designed for 50-60,000 m^3 daily capacity can use all petroleum fractions from LPG through gasolines up to heavy oils. The chemical theory of oil cracking and descriptions of plant operation with data are given, including some cost estimates.

Oil Shale

Physicochemical Properties of Green River Oil Shale. Particle Size and Particle-Size Distribution of the Inorganic Constituents. P. R. Tisot and W. I. R. Murphy. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

As part of a research project established to study the physicochemical properties of Green River oil shale, information was developed relating to particle size, particle-size distribution, and geometric form of the primary inorganic particles that constitute the inorganic phase of oil shale. This information contributes to a better understanding of the structure of oil shale.

Olefins

I.C.I.'s New Olefine Plant. Wilton Works Now Largest Petrochemical Complex Outside U.S.A. *Petrol. 22,* 351 (1959) Oct. (3 pp.)

Third olefin plant at Wilton works, Yorkshire, England, which came into production recently, raises I.C.I.'s total olefin capacity by 60%. With the two other plants, there is sufficient capacity to process 600,000 tons of feedstock/yr to yield about 230,000 tons of olefins. Output of the chief product, ethylene, now is about 110,000 tons/yr. The works is the world's largest based on liquid feedstock.

Modern Route to Ethylene and Propylene. R. A. Labine. *Chem. Eng. 66,* 118 (1959) Oct. 5 (4 pp.)

Petroleum Chemicals, Inc., planning a probable expansion to full-scale production next year at its Lake Charles, La., petrochemical plant, is now making 200 million lb/yr of high-purity ethylene and 15-25,000 bbl/month of propylene. PCI pegs ultimate plant capacity at 300 million lb/yr of ethylene; propylene output varies with demand. Plant departure from conventional routes is described.

Petrochemicals

Process for the Economical Utilization of Idle Standby Oil Gas Plants to Produce Low-Cost Petrochemicals. V. Stark and E. Parker. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Process proposes operating standby gas plants all year around producing oil gas of high heat value (1250 Btu/CF) containing 35% unsaturated and aromatic hydrocarbons. Schemes of hydrocarbon recovery are outlined, including passing of residual gas through a catalyst, obtaining styrene and cumene in addition to basic petrochemicals. Based on present market conditions in New England, for a typical plant of 6000 MCF/day, the upgrading, depending on the scheme used, is from 1.42-9.88. Considering 50% equity, net income after taxes is estimated at 21-72%, and payout after taxes at 4.7-2.1 years.

Taking 5 years as basic payout for a plant of 10,000 MCF/day, ethylene can be produced at $0.025/lb and styrene at $0.08/lb.

Radioactivity Applications

Effect of Gamma Radiation upon the Hydrocracking of a Heavy Paraffin. E. J. Henley. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Commerial paraffin wax of molecular weight 345 was subjected to a cobalt-60 gamma-ray flux of 46,000 Roentgens/hr at 500°-900° F, and 1000-3000 psia hydrogen pressure. Cracking begins at approximately 860° F, this threshold being independent of radiation dose. Cracked gases were analyzed for C_1-C_4 hydrocarbons, there being no change in spectrum of products with irradiation. At 900° F and a dosage of 92,000 Roentgens, 0.00109 mole of gas were produced per gram of wax, in comparison with the thermal yield of 0.00104. This corresponds to a *G* value (molecules formed per 100 ev) of 79,000.

Radiation Processing. E. J. Henley and H. W. Chandler. *Ind. Eng. Chem. 51*, 1395 (1959) Nov. (8 pp.)

This review was written in an effort to collect the scattered information on different types of radiation processing, and attempt to classify it. Applications for the various types of radiation have been found in almost every conceivable industry. At the present time the use of ionizing radiation is restricted to the processing of various plastics and the sterilization of pharmaceuticals. The large amount of research being carried out in this field seems to indicate, however, that other applications will eventually be developed. Other more well known types of radiation such as ultraviolet and radiofrequency are at a more advanced stage of development, and consequently have wider applications. Other newer techniques such as plasma generation and high-frequency discharge are being developed and their use should spread as more becomes known of their applications.

Irradiation Studies of Coal and Its By-Products. Effect of Radiation and Oxidation at Ambient Temperatures on the Subsequent Plasticity of Bituminous Coals. F. Rusinko, Jr., A. Weinstein and P. L. Walker, Jr. Atlantic City: American Chemical Society (Division of Gas and Fuel Chemistry), 1959.

Eight Pennsylvania bituminous coals (−40 mesh held in closed containers) were each irradiated to a total dosage of 3.8×10^8 rads at ambient temperatures in the presence of varying amounts of oxygen. For six of the coals, vacuum-irradiation resulted in a negligible change in fluidity. For two of the high volatile A coals, a significant decrease in fluidity was found. For six of the coals, air-irradiation resulted in a significant (and in some cases very large) increase in fluidity. For two of the coals, air irradiation had a negligible effect on fluidity. The effect of oxygen-irradiation on the fluidity of the coals is more varied. For five of the six high volatile A coals, oxygen-irradiation substantially lowered the fluidity below that of the corresponding unirradiated coals. For one high volatile A coal and a medium volatile coal, oxygen-irradiation increased the fluidity over that of the unirradiated coals. Oxygen-irradiation had a negligible effect on the fluidity of the low volatile coal.

Reformed Gas

Reforming of Natural Gas. P. A. Toynbee. *Coke and Gas 21*, 402 (1959) Oct. (10 pp.)

Small plant for the partial oxidation of natural gas with air has been constructed and operated at the works of the New Plymouth Gas Co., New Zealand. The natural gas is converted to a gas with a calorific value of about 185 Btu/CF and containing about 22% of hydrogen. The town gas resulting from the mixing of reformed gas, natural gas and coal gas is interchangeable with the normal coal gas. The reforming of part of the natural gas thus permits use in the town gas supply of all the available natural gas.

Coal Gasification

Combustion of Finely Divided Low Volatile Carbonaceous Solid Fuels. E. Gorin (assigned to Consolidation Coal Co.) U.S. 2,903,980 (1959) Sept. 15.

Finely pulverized, low volatile carbonaceous fuels are fired in a pulverized fuel burner system by adding between the fuel bin and burner a fluidization stage in which a partial combustion and gasification occur at elevated temperatures, with the combustible gas and unreacted solids being carried forward in dilute phase to the main burner.

Gasification

Gaseous Fuel Generator. U. F. Gochoel (assigned to Vapo-Gas Corp.) U.S. 2,905,800 (1959) Sept. 22.

Improved gasoline-air gas generator is claimed comprising a panlike liquid reservoir and vaporizing chamber with float-controlled fuel feed and an electrically heated absorbent pad arranged to be intermittently wetted with fuel while in the path of a regulated compressed air stream.

Production of Fuel Gas and Liquid Hydrocarbon Fuels. W. A. McCarthy (assigned to Phillips Petroleum Co.) U.S. 2,905,622 (1959) Sept. 22.

In a catalytic cracking process for gas oils, an improved catalyst regeneration step is claimed in which high CO_2 gases (12%) from the "burning-off" of deposited coke from a first reaction zone are passed to a second reaction zone at 1030-1150° F, also containing coke-coated catalyst, where the CO_2 is converted to obtain off-gas of enhanced heating value.

Suspension Process for the Production of CO and H_2 from a Solid Carbonaceous Fuel, Oxygen and Steam. F. Totzek (assigned to Koppers Company, Inc.) U.S. 2,905,544 (1959) Sept. 22.

This process for producing carbon monoxide and hydrogen consists of forming a suspension of the finely pulverized coal in free oxygen at a temperature below the ignition point, so that only a part of the coal is reacted exothermically. Then this suspension is injected with steam as a jet axially into a reaction zone at 1200°-1600° C to complete the gasification. The reactor wall is protected by injecting steam to form a wall blanket. This wall blanket also permits an adjustment of the shift reaction to be made.

Hydrogen

Diffusion Process and Apparatus. A. M. Henke and W. A. Horne (assigned to Gulf Research & Development Corp.) U.S. 2,902,111 (1959) Sept. 1.

Process is claimed for separating hydrogen from a gas mixture which comprises passing this mixture and a condensable "filtering" gas in concurrent, horizontal laminar flow through an unobstructed, constant temperature zone and recovering two gas streams from this zone. One of the streams comprises the filtering gas enriched with the more diffusible component (hydrogen) of the gas mixture. The enriched filtering gas may be condensed to release the hydrogen and then may again be recirculated.

Synthesis Gas

Process for the Production of Synthesis Gas and the Like. J. A. te Nuyl (assigned to Shell Development Co.) U.S. 2,904,417 (1959) Sept. 15.

Process for preparing gas mixtures, chiefly hydrogen and carbon monoxide, is claimed in which air insufficient for complete combustion is fed tangentially with steam to form an annular rotating column which blends with gas or oil injected centrally as the mixture passes through a restricted orifice into an expanded combustion chamber. Pressures of 3-30 atm and temperatures in the range of 1200-1500° C are maintained.

8. GAS DISTRIBUTION

Distribution Systems

Integration in the South West. T. W. Jackson. *Gas J.* (Survey of Distribution), 60 (1959) (5 pp.)

Before nationalization of the gas industry in Great Britain, the consumers serviced by the South Western Gas Board were supplied by 60 statutory and 43 non-statutory undertakings with a total of 108 separate works. Today's grid consists of 124 holder stations which are supplied by 13 manufacturing stations through a network of 1267 miles of high pressure mains, which also supply many small communities. Plans for integrating or closing down 11 more works are well advanced. The integration scheme has been constantly under review in the light of new production techniques, but it now appears that when the scheme is finally completed, there will be 143 holder stations supplied by ten major works, with only the one isolated works at Bude.

Scotland's Grid. R. O. Emmony. *Gas J.* (Survey of Distribution), 65 (1959) (4 pp.)

At vesting date there were 196 gasworks in operation in Scotland, including three subsequently purchased from the Scottish Division of the National Coal Board and one coke-oven gas purification station. When completed, the total length of grid mains within the area of the Scottish Gas Board, both the high pressure steel pipeline operating at 250 psi and the ordinary grid mains operating at up to 25 psi, will be of the order of 1100 miles of which approximately 685 miles have been laid to date.

Towards a National Grid. Problems of Gas Transmission and Bulk Distribution in Great Britain. A. D. L. Copp. *Gas J.* (Survey of Distribution), 56 (1959) (4 pp.)

Gas grid on a national scale is desirable in the foreseeable future and planning should be undertaken, according to author. At present, full use of such a grid could not be made as the necessary sources of gas are not sufficiently developed, nor is there any underground storage available. No new large-capacity pipeline should be constructed, says author, without thought as to its future role on a national basis, and it would seem that extensions of conventional gas-making plant should be obviated. A national gas grid is both logical and inevitable. Examples of bulk distribution by simple feeder-main, the long-distance transmission pipeline and the grid in the U.S., Germany and France are given.

Mains

Line Sizing Chart for Gases. R. B. Ritter. *Chem. Eng. 66*, 193 (1959) Oct. 19 (2 pp.)

Chart presented is particularly useful for sizing mains and branch lines of steam, air or fuel-gas distribution systems in chemical processing plants and refineries. It is not intended for sizing long gas transmission lines or lines built of expensive alloys. Such special cases are best sized by individual economic studies.

Piping

Locating Non-Metallic Pipe. G. M. MacLeod. *Gas 35,* 73 (1959) Nov.

Commercial pipe finders are, in effect, metal detectors. Secret of locating non-metallic pipe is to introduce metal into or immediately adjacent to lost and buried non-metallic line. Perhaps the most common way is through the insertion of a sewer snake or clean out rod assembly into the missing line at some known location. Pipe finder transmitter is connected directly to the sewer rod. The rod then becomes a radio transmitting antenna. Location and depth of the extended sewer rod or snake can then be mapped with the pipe finder receiver and with it the pipe. This technique has been used regularly to locate the extensions of non-metallic sewer lines. There is no reason why it cannot be used for other similar application.

New Type of Search Coil for Metal-Pipe Location. J. A. Phillips and H. H. Wills. *J. Sci. Instruments 36,* 399 (1959) Sept. (2 pp.)

Method of tracing metal pipes, involving the amplification of the voltage induced in a special type of search coil by transient current injected into the pipe is described. The search coil consists of two identical flat coils mounted side by side in the same plane, and so connected that the output voltage is equal to the difference of the voltages induced in the two coils. An audible signal is obtained in headphones after amplification of the output voltage. It is found that, with this twin coil system, the signal strength varies approximately at $1/R^2$, where R is the perpendicular distance from the pipe to the search coil, and that a more reliable performance is obtained compared with the usual single type of search coil.

Telemetering

Remote Control Systems in Gas Distribution. L. S. James, *Gas J.* (Survey of Distribution), 92 (1959) (11 pp.)

Article commences with a brief survey of the historical background to remote control both in terms of its application to grid control and of items of equipment in the electrical signalling systems which have become established. The various control methods and the electrical units involved are classified and their functions summarized in accordance with generally adopted practice. The concluding section is a review of the larger and longer established centralized control installations with an indication, also, of the extent to which this means of control has been adopted by the various area gas boards.

Leakage

Patch for Repairing Leak Holes in Pipe Lines and Method for Applying the Same. A. M. Creighton, Jr. (assigned to Chemical Development Corp.) U.S. 2,905,206 (1959) Sept. 22.

Improved patch and patching method for small leaks in pipelines is claimed in which a steel plate patch faced with a rubber gasket is clamped by a C-clamp over the leak, the immediate area cleaned and a strong resin of epoxy type, with powdered steel filler, is packed around the patch and hardened by curing agents.

9. GAS FUEL UTILIZATION AND APPLIANCES

Absorption Cooling

Bryant Develops an Efficient and Flexible Gas Air Conditioner. *Appliance Manufacturer 7,* 84 (1959) Oct. (7 pp.)

Gas-fired, air-cooled remote air conditioner engineered by Bryant Manufacturing Co. combines some unique features with the basic ammonia-water absorption system. Several short cuts were taken to simplify the unit and to increase its operating efficiency. For example, the heat exchanger was designed to utilize every Btu possible of the input heat. The absorber is air-cooled; its design provides maximum absorption of the ammonia refrigerant by the water absorbent. Heat-generated pressure and gravity circulate the absorbent and refrigerant. There are only one pump and two motors in the whole unit.

Air Conditioning

Free-Piston Compressors May Power Air Conditioning Systems. J. H. McNinch, R. J. McCrory and R. W. King. *ASHRAE J. 1,* 55 (1959) Nov. (5 pp.)

Answering a question posed by the American Gas Association, "How can the potential energy in natural gas be transformed into a refrigerating effect with high efficiency and low first equipment cost in such a way as to be attractive for residential air conditioning service?", the Battelle research group developed the free-piston compressor. The approach was to combine the spark-ignition gas engine and the vapor-compression refrigeration cycle in such a way that the initial installment, maintenance costs and

the noise level would not be deterrents to its general acceptance. The compressor is desgined for efficiency and low cost production, but it does not yet have a manufacturer.

Radiant Heat Control in Industrial Plants. W. G. Hazard. *ASHRAE J. 1,* 73 (1959) Nov. (5 pp.)
In order to provide comfortable working conditions in large industrial plants, serious obstacles must be contended with—heat released from the equipment, shape of buildings, and a lack of understanding of basic causes of discomfort. Often, the importance of radiated, radiant or infrared heat is not realized fully. Article describes radiant heat problems and offers solutions. At the same time, the significance of proper ventilation is stressed.

Air Pollution

Air Pollution and the Petroleum Industry. D. S. Fraser. *Petrol. 22,* 344 (1959) Oct. (3 pp.)
Problems ranging from seismic surveying to water supply and cleaning of old mine fields are discussed.

The Clean Air Act: Requirements and Application. C. M. Opie. *J. Inst. Fuel 32,* 421 (1959) Sept. (5 pp.)
Clean Air Act, Great Britain 1956, forbids the emission of dark smoke except for short specific periods, and requires that grit and dust shall be reduced by fitting efficient grit arresters. In addition to strengthening control over industrial smoke, it provides for the prevention of smoke from domestic houses; this will be done through the establishment of smoke-control areas. Local authorities must be advised of the installation of new furnaces, and prior approval can be obtained. Other sections deal with railway engines, vessels, Crown premises and transitional provisions. Application of the Act to industry raises several problems. The principal difficulty is how to burn bituminous coal of all types and grades in a variety of appliances under different, and at times difficult, conditions.

Kinetics of Smog Oxidant Formation. Ozone Reaction with 1-Hexene. B. E. Saltzman and N. Gilbert. *Ind. Eng. Chem. 51,* 1415 (1959) Nov. (6 pp.)
Generation of synthetic smog oxidants by the ozone gas phase reaction with 1-hexene at low concentrations was studied using newly developed basic chemical analytical procedures. The mixtures were differentiated into "synthetic smog oxidants" and unconsumed ozone, and the reaction yield of the former was shown to be 17-25%. Part of the synthetic smog oxidants was readily adsorbed on glass and could be subsequently desorbed. The consumption of ozone was found to be first order with respect to both ozone and hexene concentrations through most of the reaction, with a rate contant of 0.0135 $\mu atm^{-1}min^{-1}$ at 22°-28° C. The methods developed and the information obtained for the oxidant components should be valuable for further study of smog reactions.

New Afterburner Looks Promising. *Oil Gas J. 57,* 48 (1959) Nov. 2 (2 pp.)
Latest device to fight Los Angeles' smog is attached directly to the manifold. The device, an afterburner, has only one working part. Engine exhaust and air from an engine-driven pump are preheated in a heat exchanger and burned in a combustion chamber. The burnt exhaust then is run back through the heat exchanger and cooled before discharge. Reports indicate that the device has eliminated 80-90% of hydrocarbons and 70% of carbon monoxides in exhausts tested in the laboratory.

Burner Controls

Balancing Systems for Groups of Gas Burners. R. J. Reed. *Ind. Gas* (Amer.) *38,* 4 (1959) Oct. (5 pp.)
Burner delivering more or less than its share of heat in a multiburner furnace or kiln can seriously lower product quality as the result of nonuniform temperature or atmosphere. This problem is intensified in modern compact and high-speed furnaces and kilns providing less space and time for leveling out the differences. Article presents a number of systems designed to eliminate problems of nonuniformity by setting all burners at equivalent firing rates and gas-air ratios.

Combustion

Basic Principles of Combustion-Model Research. A. A. Putnam and E. W. Ungar. *J. Eng. Power* (Series A) *81,* 383 (1959) Oct. (6 pp.)
Use of models to study problems encountered in the design of commercial and industrial combustion equipment is less well known than the use of their counterparts for aeronautical, hydraulic, erosion and similar studies. The basic assumptions upon which cold-flow modeling of combustion systems is carried out, the application of modeling to various combustion problems, and the type of results that should be expected from the application of modeling techniques are discussed.

Flame Research

Effect of the Electric Field upon the Spectra of the Hydrocarbon Diffusion Flame. J. Nakamura. *Combustion and Flame 3,* 277 (1959) Sept. (8 pp.)
Supposition that there is a relationship between the mechanism of ion production and CH formation or C_2 extinction has been examined using the propane

flame, a rectangular burner and a longitudinal electric field. Rotational temperatures of CH, C_2 and OH were measured by microphotometric tracing of the spectra, and the results of measurements of relative radiational intensities are shown graphically. It is concluded that the ions in a flame are produced in the carbon formation stage.

Effect of Flow Pulsations on the Turbulent Speed of Flame Propagation. L. S. Kozachenko. *ARS J. 29* (Russian Supplement) 761 (1959) Oct. (4 pp.)

Mechanism of flame propagation in a turbulent stream is considered. A burner is described in which the degree of turbulence can be varied from 1.7-15.7%. Measurement of the turbulent characteristics by means of a glow-discharge anemometer and a thermal anemometer has shown that the glow discharge exhibits no time delay at a pulsation rate up to 20 kc and that it can be used under laboratory conditions. An experimental estimate is made of the role of flow pulsations in the transfer of the flame through the combustible mixture. Certain results are reported on the measurement of flow pulsations behind various turbulizing devices under conditions of isothermal flow and combustion of a homogeneous fuel-air mixture. It is shown that the turbulent flame speed can be represented in the form of the normal speed of propagation of the flame, the mean square pulsation of the isothermal flow and the additional pulsation generated by the flame. The setup included a fixture for measuring the flow of air and fuel in a Topler chamber for recording on motion film the dimensions of the combustion zones by means of a series of spark discharge.

Effect of Pressure on the Speed of Flame Propagation in a Turbulent Stream. S. A. Gol'denberg and V. S. Pelevin, *ARS J. 29,* (Russian Supplement) 765 (1959) Oct. (4 pp.)

Authors consider the propagation of a flame at pressures below atmospheric in thoroughly premixed combustible mixtures. Heretofore various persons have investigated mostly the response of the turbulent speed of the flame to changes in the rate of flow in the turbulence characteristics of the incident stream, the nature of the fuel and its concentration in the mixture, and also in the initial temperature of the mixture. It is noted that V. E. Doroshenko and A. I. Nikitov have carried out simultaneously research along the same lines as the authors.

Similarity Criteria for the Study of Furnace Flames by Means of Cold Models. G. G. Thurlow. *Combustion and Flame 3,* 373 (1959) Sept. (16 pp.)

Tests are reported on a small gas-fired furnace and a cold model of similar over-all dimensions. Conditions in the small furnace exaggerate some of the difficulties in the use of model techniques, and the problems of buoyancy are particularly discussed. Errors caused by the incorrect estimation of the mean flame temperature also are investigated. It is concluded that reasonable agreement between the mixing of fuel and air in a hot and a cold furnace can often—though not always—be obtained though it is emphasized that this is unlikely to be better than of the order of $\pm 20\%$.

Stabilization of the Flame in Gas Flows of High Velocity. S. M. Pavlov. *Nauchno-Tekhn. Inform. Byul. Leningrad Politekhn. In-ta,* 22 (1957) No. 5 (8 pp. Russian text); *Ref. Zh. Mekh.,* (1958) No. 4 (Rev. 3811). (From *Appl. Mech. Rev. 12,* 722 (1959) Oct.)

Paper is a theoretical investigation of the problem of the stabilization of a flame by means of stabilizers of poor flowing-around properties. It is assumed that the burning mixture moves at the speed of the surrounding basic flow of combustible mixture. Again, assuming an ideal blending of the combustible mixture with the products of combustion and that the combustion reaction is describable by the principle of Arkenius and proceeds by the second order, the author obtains a theoretical relation determining the collapse of the combustion. On the basis of this relation and of known experimental data, a semi-empirical function is deduced which can be said to satisfactorily describe the limits of stabilization of the flame.

B. V. Raushenbakh

Courtesy Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Theory of Flames Produced by Unimolecular Reactions. I. Accurate Numerical Solutions. J. O. Hirschfelder and A. McCone, Jr. *Phys. Fluids 2,* 551 (1959) Sept.-Oct. (14 pp.)

Time dependent flame equations are presented in complete generality, including the effects of thermal diffusion, radiation, external forces, and pressure variations. The one-dimensional steady-state laminar flame supported by the unimolecular reaction $A \rightarrow B$ is studied carefully with special emphasis on the effects of heat transfer to the flame-holder. It is found that in agreement with Spalding's work on a somewhat different model there is a maximum amount of heat transfer which permits a steady state. For heat transfers less than this maximum there are two possible solutions of the flame velocity. The smaller of these flame velocities corresponds to an unstable mode. At exceedingly low pressures the flame velocity becomes comparable to the velocity of sound.

Theory of Flames Produced by Unimolecular Reactions. II. Ignition Temperature and Other Types of Approximations. J. O. Hirschfelder. *Phys. Fluids 2,* 565 (1959) Sept.-Oct. (10 pp.)

Ignition temperature approximation is used to explain many of the properties of flames, including the effect of heat transfer to the flameholder. The Corner, Adams, Wilde, and Klein treatments are explained. Finally, a new approximation scheme (based on the Adams and Wilde) is developed which is extremely accurate.

Furnaces

Cast High Alloy Continuous Belt and Radiant Tubes Form Heart of New Continuous Atmosphere Furnaces. E. A. Schoefer. *Ind. Heating 26,* 2017 (1959) Oct. (5 pp.); **Cast High Alloy Belts Help Conversion from Batch Heat Treating.** *Ind. Gas* (Amer.) *38,* 12 (1959) Oct. (3 pp.)

High alloy castings play a major role as key furnace parts in two new controlled atmosphere continuous conveyor furnaces recently installed by Surface Combustion Corp. at the National Screw and Mfg. Co., Cleveland. Heat resistant type HT (35% Ni, 15% Cr) cast alloy was utilized for continuous belts and radiant tubes in these heat treating units because high strength and corrosion resistance are needed.

Controlled Non-Uniform Heating Produces Uniformly Baked Coating in Fluorescent Tubes. G. E. Lambert. *Ind. Heating 26,* 2065 (1959) Oct. (6 pp.)

Six Gradiation lehrs, designed and custom-built by Selas Corp. of America are used to maintain temperature uniformity while baking the luminous coating inside of fluorescent tubes. Equipment performs this job rapidly and with the necessary precision. Speed is essential in the continuous process to maintain plant production which is at a rate of 2½ million fluorescent lamps of various sizes a month.

Design of Gradientless Furnaces. M. J. Laubitz. *Can. J. Phys. 37,* 1114 (1959) Oct. (12 pp.)

Temperature distributions in cylindrical furnaces are discussed, and design data are given which permit the construction of short furnaces in which the temperature varies less than 0.5% along the central half of the length of the heater. Formulas also are presented for the calculation of temperature distribution in conventional furnaces with uniformly wound heaters.

World's Largest Forge Stresses Quality in $20 Million Output. A. Q. Smith. *Ind. Gas* (Amer.) *38,* 10 (1959) Oct. (2 pp.)

Kropp Forge Co., Cicero, Ill., uses 68 gas-fired forge furnaces and 19 gas-fired heat treat furnaces to heat forging furnaces. Nearly 1000 employes are required in the many departments of Kropp who are staffed to handle forgings from the original design through die making, forging, heat treating and finishing of the product which may range from a few ounces per forging to large pieces weighing many tons.

Heat Treating

World-Famous Bedford Truck Components Get the Gas Treatment. E. Ford. *Gas J. 300* (Gas in Ind. Sect.) 232 (1959) Oct. 7 (6 pp.)

Gas plays an important part in the manufacturing processes at Dunstable, Bedfordshire, (Great Britain) where it is extensively used for such heat treatment techniques as hardening, tempering, normalizing and gas carburizing. The scale of operations is so extensive that the company makes impressive demands on public gas supplies, taking gas from the Eastern Gas Board at the approximate rate of 900,000 therms a year. Description of plant and equipment is presented.

Industrial Heating

Heating in the Paint Industry. H. O. Kolin. *Ind. Finishing 11,* 28 (1959) Oct. (2 pp.)

Gas heating for varnish kettles, stand oil plant, etc., has the unrivaled property of easy control and regulation, although oil-compressed air heating has proved itself superior where long periods of heating are needed. German practice is described and it is hoped shortly to publish some detailed information regarding British practice.

LPG

Utilization Aspects of Butane Addition to Town Gas. M. G. Gilbert and F. C. Moody. *Gas World 150,* 266 (1959) Sept. 26 (5 pp.); **The Effects of the Addition of Butane to Town Gas on Its Combustion Characteristics.** *Gas J. 300,* 33 (1959) Oct. 7 (7 pp.)

For base load supplies, a wide range of oil fractions are being reformed in Onia-Gegi and Segas plants to provide gases with properties similar to those of normal town gas, while in certain isolated areas a mixture of butane and air is being used as an alternative to conventional town gas. To supplement the normal gas supplies at times of peak demand, butane-air mixtures can be added, or direct enrichment of gas of low calorific value with butane made in addition to other methods of producing peak load oil gases from oil fractions.

Refrigerators

Some Refrigerators Are Still too Noisy. E. A. Baillif and J. P. Laughlin. *ASHRAE J. 1,* 64 (1959) Nov. (8 pp.)

Best way to eliminate noise is to design it out is a conclusion of the authors. They further argue that

basic instruments are really only the starting point in analyzing noise and can be supplemented by special apparatus, limited only by the imagination of the engineer, to attack any phase of the compressor as a noise generator. An example of a special test method used in the study reported is found in the use of magnetic pick-ups on a rotating part of the compressor in combination with a capacitive pick-up formed from the discharge valve of the compressor, to investigate the effect of compressor valve action on the noise spectrum.

Space Heaters

Bathroom Heater Employing Thermoelectric Principle Developed by Lone Star Gas Co. *Gas Age 124,* 30 (2959) Oct. 15 (2 pp.)

New concept in gas-fueled bathroom heaters combines the use of a recently developed radiant type burner for its heat source and a series of 24 small thermocouples to generate thermoelectric energy. The latter powers a built-in handling fan to increase efficiency of the unit by recovering a portion of the exhaust heat. The automatic valve controls are also operated by thermoelectricity.

Standardization Simplifies Output. *Appliance Manfacturer 7,* 58 (1959) Oct. (2 pp.)

Wide range of sizes and types of gas and oil warm air furnaces required for the residential heating market presents unusual production standardization problems. The Mueller Climatrol Division of Worthington Corp., Milwaukee, Wis., has been able to overcome this problem in part by standardization of individual components, and at the same time retain flexibility of design of the end product. Company uses one basic heating element for all its gas furnaces.

Space Heating

Control Methods for Radiant Heat. K. L. Dunn. *Air Conditioning, Heating and Ventilating 56,* 73 (1959) Nov. (3 pp.)

Materials commonly regarded as good for heat insulation or reflection were abandoned, for this study, when it was discovered they had low reflectivity to the infrared portion of the spectrum. Aluminum metal seemed to be the ideal choice from the standpoint of cost and maintenance. Several new materials have been created recently, however, one of the most interesting of which is a transparent glass that possesses up to 70% reflectivity to radiant heat. This allows many applications of radiant heat shielding, previously impractical, where high visibility is needed and where radiation reduction is imperative.

High Intensity Infrared Radiant Heating. *Heating, Piping and Air Conditioning 31,* 139 (1959) Nov. (16 pp.)

Fundamentals of radiant heat transfer are presented with emphasis on their application to space heating applications. How to calculate radiant heat exchange, how radiant heating affects comfort sensations, and what to consider when selecting and locating the radiant heating unit are some of the topics covered. While the energy involved in this type of heating is the same in nature as that emitted by conventional hot water radiant panels, it is introduced into the space at a much higher intensity and, therefore, some differences in application must be considered if acceptable comfort levels are to be provided.

The Physiological Effects of Heat. J. B. Moses. *Air Conditioning, Heating and Ventilating 56,* 69 (1959) Nov. (3 pp.)

Increase in the production of heat by muscular work must be balanced by an increase in the rate of heat loss. In environments above skin temperature, the body gains heat through radiation and convection. This increase in heat load, together with heat generated by normal functions such as metabolism, must be eliminated by the only remaining avenue — evaporation. Large amounts of heat thus can be dissipated. The limit of evaporation is reached when the body surface becomes fully wetted; and if the heat load exceeds that of the maximum evaporation capacity, the body heat rises.

Steam Generation

Converting to Gas Firing? J. M. Totten. *Power 102,* 78 (1959) Nov. (2 pp.)

Conversion of coal or oil fueled boiler plants to natural gas often raises some problems. These and their possible solutions depend on the characteristics of the existing boiler and include burner placement, gas burner types, draft system, final steam temperature, steaming capacity, standby fuel supply, automatic combustion control, ignition devices, and heat-liberation rates.

Water Heaters

Gas Water Heating Equipment. Part 3. Application and Service. F. Lowe. *Gas Heat and Comfort Cooling 10,* 38 (1959) Nov. (4 pp.)

In last of three articles on gas-fired water heating equipment, the author covers two-temperature water applications and the effects of hard water on various equipment. In conclusion he presents some helpful guides on servicing heaters and heater controls.

Burners

Burner with Flame Shaping Means. J. W. Dolby (assigned to Configured Tube Products Co.) U.S. 2,905,235 (1959) Sept. 22.

Gas burner is claimed, comprising a fuel-air mixing tube with gas nozzle entraining air, mixing through a Venturi throat, with a flame target consisting of two inclined metal bars supported by bars longitudinally beyond the burner port to spread and shape the flame.

Radiant Cup Type Gas Burner. E. Blaha (assigned to Selas Corp. of America.) U.S. 2,904,108 (1959) Sept. 15.

In a radiant cup type gas burner an improved gas distributing head is claimed which consists of a cylindrical ceramic mass, with enlarged or ledged burner end, designed to fit centrally into the radiant cup of the wall. The cylindrical surface of the distributor is fluted with parallel grooves which bend radially outward in the ledged end, terminating in both edge and face of ledge, so as to direct the fuel air mixture in a radial blast toward the inner face of the cup.

Burner Controls

Top Burner Thermostat. L. B. Wagner (assigned to Penn Controls, Inc.) U.S. 2,903,890 (1959) Sept. 15.

Improved top burner thermostat assembly is claimed in which the temperature-sensitive disc element is supported on the closed top of a cylindrical shield, fitted centrally in the burner. The shield is supported by a spring to permit short vertical motion of the shield-disc assembly on a smaller diameter sleeve whether the pan is on or off the burner. A coiled capillary tube extends centrally from the disc to the diaphragm of the valve-controlling thermostat. Air slots in the cylindrical shield permit cooling of the thermo-assembly at high burner rates and permit radiation from burner to activate the central sensing disc at low rates.

10. EQUIPMENT AND INSTRUMENTATION

Computers

Humble's IBM 705 Distillation Program. *Oil Gas J. 57,* 108 (1959) Oct. 19 (2 pp.)

Now available to industry is Humble Oil and Refining Co.'s IBM 705 program for conventional towers (single feed and an overhead and bottoms product). This procedure utilizes an improved Thiele and Geddes method for rigorous plate-to-plate calculation on an existing fractionating column.

Contactors

How Random Is Random Packing? K. E. Porter. *Chem. Process Eng. 40,* 303 (1959) Sept. (3 pp.)

It is important to know how the disposition of the packings in a random-packed tower affects the distribution of the liquid and, particularly, what contribution it makes toward the undesirable "wall effect". Article discusses investigations, using photography and mathematical methods, which throw light on the problem.

Performance Characteristics of "Intalox" Saddles. J. A. Field. *Chem. Process Eng. 40,* 310 (1959) Sept. (2 pp.)

"Intalox" saddle was designed to overcome disadvantages of other types of tower packings. The shape is such that adjacent elements do not blank off any significant portion of their surface and a high proportion of the available surface is accessible to the wetting liquid; no stagnant pools of liquid form and no bubbles of gas are trapped. In a bed of "Intalox" saddles the voids are uniform and all surfaces are smoothly rounded; consequently gas passing through the bed is not subjected to violent changes of direction. This contributes to the remarkably low pressure drop experienced in industrial installations. Another factor is the free flow of liquid over the curved surfaces, which minimizes liquid "hold-up".

Selection of Tower Packings and Accessories. D. G. Randall. *Chem. Process Eng. 40,* 306 (1959) Sept. (5 pp.)

There are many factors to be considered before what type of tower packings are best for a particular duty; what size the packings should be, and whether they should be metal or ceramic. Problems are discussed and some points about the design of packed towers are presented. Thirteen main types of tower packings are described in tabular form according to material: ceramic, metal, and wire and mesh types.

Fluidization

Removal of a Mist in a Fluidized Bed. D. S. Scott and D. A. Guthrie. *Can. J. Chem. Eng. 37,* 200 (1959) Oct. (4 pp.)

Removal of droplets from a dioctyl phthalate mist by a fluidized bed of silica gel was studied. The mist used had a narrow range of droplet diameters, which averaged 8.87 microns in size. Silica gel particles were in the range of −150 to 200 mesh. It was found that removal efficiencies were only slightly affected by a 50% change in inlet mist concentration, or by a 300% variation in depth of the fluidized bed. Collection efficiencies varied from about 90% at low superficial gas velocities to 70% at high velocities. It is shown from these results that collection is primarily by particle diffusion. Results can be correlated

in terms of equations for mass transfer in fluidized beds. The possible uses of a fluidized bed as a collecting device are discussed.

Gas Turbines

Gas Turbine Powered Drilling Rig. C. R. Apitz. *Petrol. Eng.* (Drilling and Producing) *31*, B-34 (1959) Nov. (3 pp.)

Freeport Sulphur Co. powers its drilling rig and all platform power requirements on its Grand Isle offshore platform sulfur mine with a 1265-hp simple open cycle gas turbine which provides both d-c and a-c power for drilling and construction needs.

The World's First Gas Turbine Tanker. *World Petrol. 30*, 52 (1959) Oct. (2 pp.)

First tanker to be driven entirely by a gas turbine, the 12,000 dwt "AURIS" of Shell Tankers Ltd., has successfully completed extensive sea trials and joined the Shell fleet. It is powered by a 5500 bhp (brake horsepower) open cycle gas turbine designed by British Thomson-Houston Co. and built partly by them and partly by Cammell Laird & Co. Shell sees potentialities for this type of vessel propulsion in methane carrier or coupled with nuclear drive.

Pilot Plants

An Engineer Contractor Looks at the Pilot Plant. G. B. Zimmerman and T. A. Duncan. *Chem. Eng. Progress 55*, 68 (1959) Oct. (3 pp.)

There is a growing appreciation of the fact that the designer of commercial plants should participate in the pilot-plant phase of new process development. Ultimate purpose of a pilot plant is the purchase of time at the best possible price, and the determination of the most effective means of the necessary data required for the design of a profit-making commercial plant. Engineer-contractor is oriented toward eventual design and construction of full-scale plants. He is able to introduce into pilot-plant programming a number of important elements which otherwise might not receive early consideration. This premise is based on the assumption that the engineer-contractor will assume the responsibilities for the design and installation of the pilot plant.

Piping

Piping Stress Analysis Simplified. J. S. Moloney. *Petrol. Refiner 38*, 133 (1959) Oct. (6 pp.)

General method is presented for determining the moments forces and stresses in piping systems. It can be applied to very simple as well as to more complex lines. Method can be used to evaluate the effects of thermal expansion as well as those of extraneous forces and movements. It is relatively rapid as compared with other methods which claim a complete solution. Moreover, it gives accurate results. Method is based on the moment distribution and stress relaxation methods of Hardy Cross and of Southwell, but contains certain features which make it a special adaptation of these.

Use These Charts for Fast Pipe Sizing. G. C. Lammers and W. G. Otis. *Petrol. Refiner 38*, 127 (1959) Oct. (6 pp.)

Pipe sizing is a formidable task when a large number of lines must be designed. Article contains charts which have been developed from standard, acceptable pipe flow equations to take some of the tedium out of such calculations, and to save time.

Radiation Detectors

Sensitive Detector of γ-radiation in Liquid or Gaseous Effluents. J. G. Mitchell. *J. Sci. Instruments 36*, 396 (1959) Sept. (3 pp.)

Instrument described is a plastic-phosphor scintillation-type detector which can be used to monitor the radioactivity of liquid and gaseous effluents. With liquid effluents, it can detect activities of about 1.5×10^{-6} $\mu c/cm^3$ of 0.7 MeV γ-radiation, and for gaseous effluents, 1/280 mpc of ^{41}A in air. The experimental determination of the optimum sensitivity of the detector system is described and results are given. The system provides a continuous day and night record of the activities monitored. Also, it gives automatic warning of dangerously high levels of activity and of a failure in its own electrical system.

Temperature Measurement

Power Test Code Thermometer Wells. J. W. Murdock. *J. Eng. Power* (Series A) *81*, 403 (1959) Oct. (14 pp.)

Design of thermometer wells involves strength and thermal considerations. Criteria for thermal evaluation have been well-established, those for strength have not. Article presents thermometer-well designs proposed for Power Test Code work. Forces imposed by static pressure, steady-state fluid impingement, vibration induced by Karman trail vortexes, and structure-borne vibration are discussed. Methods and equations are given to enable the selection of wells for given service conditions. Although these methods are confined to wells of Power Test Code design, the appendix contains derivations of general equations that may be adapted for any cantilever-type thermometer well.

Thermistors — A Survey of Their Application in Temperature Measurement and Control. P. A. Atkins and R. A. Setterington. *Instrument Practice 13*, 1042 (1959) Oct. (6 pp.)

Name "thermistor" was coined from a contraction of the words thermal resistor and, as the term implies, the device is a resistive circuit element in which the resistance varies purely as a function of temperature. Thermistor material consists of a mixture of metallic oxide which, when sintered at elevated temperatures, forms a semiconductor having a negative temperature coefficient of resistance of about $-4\%/°C$ at 20° C or approximately ten times that of copper. Research and development is continuing to improve thermistor performance and widen the operating temperature range. Moreover, thermal measurement by no means represents the limit of their capabilities and they have proved able to compete on equal terms in many fields with other components which are more specialized in their application.

Valves

Reducing Valves and Their Flow Characteristics. J. Tinneveld and J. R. Peacock. *Coke and Gas 36,* 418 (1959) Oct. (7 pp.)

Reducing valves are manufactured in a great variety of forms but may all be classified under one of the following categories: 1) Condenser-type; 2) full bore type; 3) relay-operated full bore type and 4) pneumatic diaphragm-operated type. Consideration of the types available and the factors that affect their usage in steam systems, together with brief notes on determination of sizes, is presented.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Cathodic Protection of Domestic Gas-Fired Hot Water Storage Tanks. R. C. Weast. (New York: A.G.A., Project DJ-5-WH, 1959, Sept., $1.50.)

Brief discussion of theories of corrosion and cathodic protection as applied to steel exposed to hot potable waters is presented. They are used for interpretation of results obtained from research on application of cathodic protection to gas-fired hot water tanks. The research included a study of some factors which are believed to influence the distribution of current to different areas of glass lined water heaters, determination of the potential of steel at which it ceases to corrode in certain hot waters and investigation of a possible means for extending the life of magnesium anodes.

Studies on the Susceptibility of Cathodically Protected Steel to Hydrogen Embrittlement. W. H. Bruckner and K. M. Myles. *Corrosion 15,* 591t (1959) Nov. (5 pp.)

Cathodically protected sections of hot-rolled 2-in. steel pipe were subjected to low temperature bend tests. The steels tested were API grades A, B and M (N-80). The presence of a reducible Fe O portion of the mill scale delayed hydrogen absorption. Embrittlement of Grades A and B occurred due to notch formation when adherence of Fe O to base metal was destroyed during cathodic protection. Under condition of low *pH* with and without sulfide ion, cathodic protection induced hydrogen absorption and with sulfide ions present embrittlement of steels A and B was severe. Steel M (normalized) was found to be insensitive to embrittlement during cathodic protection. For the M steel cathodic protection for ten months under conditions of high tensile stress and excessive protection gave no indication of static failure or loss of strength and ductility in destructive tests upon removal from cathodic protection.

Coatings

Controlling Internal Corrosion of Tank Ships. J. F. Koehler. *Corrosion 15,* 557t (1959) Nov. (4 pp.)

Some of the measures taken by Esso Standard Oil Co. to control internal corrosion in its tankers are described. These include partial and complete cathodic protection, inhibition, coatings and combinations of these methods. Some of the economics of the various control measures are discussed and tabulated. Coatings currently are considered to offer the best promise of adequate control at lowest costs. Experience with coatings on Esso tankers is related. Relative advantages and disadvantages of and the economic aspects of the available control measures are considered.

Corrosion

Equivalent Electrical Circuit Analogy of Structure-to-Soil Potentials. R. O. Dean. *Corrosion 15,* 576t (1959) Nov. (5 pp.)

Data obtained from structure-to-soil potential measurements, even when made with extreme care and precision, sometimes appear to be erratic and anomalous. The "electrical equivalent circuit" analogy is very helpful in understanding and analyzing these measurements; it explains why the placement of the reference electrode is sometimes unimportant, while at other times it may be very critical and why the measurement of structure-to-soil potentials cannot be considered an indication of interference unless properly evaluated in connection with all associated factors.

Instruments for Measurements in Underground Corrosion Work. K. G. Compton. *Corrosion 15,* 571t (1959) Nov. (5 pp.)

Instruments commonly used for measuring electrical currents and potentials associated with corrosion of underground structures are described and their circuits explained. Considered are voltmeters, various kinds of potentiometer voltmeters and electrodes. Limitations of accuracy and fundamental principles of the use of instruments are given. Measurements described include resistivity and resistance, and special measurements, such as polarization current. Function and characteristics of combination instruments are described. Instruments are illustrated and schematic circuit diagrams given.

Ultrasonic Measurement of Tank Ship Corrosion Losses. D. J. Evans. *Corrosion 15,* 561t (1959) Nov. (5 pp.)

Method of making nondestructive thickness measurements from one side on steel, especially in tank ships, using an ultrasonic gauge, is described. Accuracy of the "slide rule" method of calibration is detailed, and the various sources of error examined and means of compensating for them explained. Merits of the cathode ray tube resonance instrument are explained and its efficiencies over earlier instruments outlined. New techniques developed during experience in react years are described and some changes in attitude toward earlier accepted procedures explained. Manner in which data are recorded is shown in tables.

Inhibitors

Electrical Resistance Method for Studying Corrosion Inhibitors in Automotive Anti-Freezes. J. C. Cessna, *Corrosion 15,* 670t (1959) Nov. (6 pp.)

Electrical resistance method has been employed to evaluate corrosion and corrosion inhibition in ethylene glycol-water solutions. Corrosion decreases the cross section of a metallic specimen with a subsequent increase in resistance. The extent of corrosion can then be determined from the change in resistance. The corrosion of iron, aluminum and cuprous metals is reported under varying test conditions of temperature, glycol concentrations and synthetic waters. The effect of some corrosion inhibitors upon these metals is illustrated.

Low Temperature Materials

Materials of Construction for Sub-Zero Temperature Service. M. Palmer. *Petrol. Refiner 38,* 107 (1959) Oct. (3 pp.)

Material behavior, relative costs, availability and mechanical design should all be considered when selecting materials for low temperature service. Article presents, in general terms, some materials of construction and discusses the mechanical design of piping and equipment in rather broad terms.

12. ANALYTICAL METHODS AND TESTS

Chromatography

Condensing System for Determination of Trace Impurities in Gases by Gas Chromatography. N. Brenner and L. S. Ettre. *Anal. Chem. 31,* 1815 (1959) Nov. (4 pp.)

Simple accessory suitable for analysis of trace impurities at the ppm level consists of a condenser column which can be substituted for the sampling volume tube in the Perkin-Elmer precision gas sampling system. This condenser column can be fitted with selected column materials, depending upon the problem. The new condenser system makes it possible to concentrate trace impurities from large sample volumes. Using large enough sample volumes, the minimum detectability of the system is at or below 0.1 ppm.

The Methodology of Hydrocarbon Gas Analysis by Gas Chromatography. G. Scharfe. *Erdol u. Kohle 12,* 723 (1959) Sept. (6 pp. German text.)

Multiple-unit rapid analysis of chromatographic type is described, as used by Farbenfabriken Bayer AG, Leverkusen, in research on cracked petroleum gases. Twelve chromatographic columns which include two hydrogenation units permit complete analysis of cracked oil gases up to C_5 and C_6 with isomers. Mixtures up to 40 components require 2 hours.

Coal

Car Dumper Coal Sampling. W. R. Reichenstein and A. Bur. *Coal Utilization 13,* 27 (1959) Oct. (3 pp.)

Coal sampling method is described in which mine identity is preserved, as well as complete representation of sample. This consists of three 8-in. pipes fixed to the railroad car dumper frame, with ports cut to admit up to 5-in. lumps while the coal stream is falling at right angles to the pipes. The pipes later discharge the collected samples (120-160 lb.) to a belt feeder which conveys coal to the hammer mill crusher for reduction to minus ¼-in. size.

Coke

The Size of Domestic Coke. N. G. Bradbury and G. E. Hall. *Gas World 150* (Coking Section), 21 (1959) Oct. 3 (9 pp.)

Article attempts to stress the importance of coke size both in test work and in manufacture and

marketing. Recent work at Acton (Great Britain) testing station has been shown to be supplementary to the earlier work published by the British Coke Research Association (B.C.R.A.) in 1953 and further evidence has been obtained in support of the rational size policy put forward by the B.C.R.A. at that time. To obtain this evidence it was necessary to explore in some detail the methods available.

Gas Analysis

An Evaluation of Three Electronic Methods to Analyze Drilling Fluid Gases. R. E. Jenkins. *Petrol. Eng. 31,* B-75 (1959) Oct. (7 pp.)

Electronic gas analyzers—the chromatograph, the infrared analyzer and the mass spectrometer—have been regarded as miracle makers as well as unnecessary. An understanding of the principles on which they operate and of their advantages and disadvantages will show that they do have great capabilities. But they also have limitations . . . and, of course, the data obtained with their use still is subject to human interpretation.

Hydrogen Sulfide

New Observations on the Low Temperature Reaction between Hydrogen Sulphide and Sulphur Dioxide: A Novel Method for Analysing Milligram Quantities of Hydrogen Sulphide in the Presence of Carbon Dioxide. I. K. Gregor and R. L. Martin. *Australian J. Chem. 12,* 424 (1959) Aug. (6 pp.)

When an anhydrous mixture of liquid hydrogen sulfide and liquid sulfur dioxide contained in a sealed tube at −78° C is gently warmed, the liquid remains clear until the temperature reaches *c.* −40° C, when sulfur is slowly deposited. Careful measurements reveal that the two compounds always react in the mole ratio, $H_2S:SO_2 = 3:2$, which contrasts with the stoichiometric equation $2H_2S + SO_2 = 2H_2O + 3S$, widely quoted for their reaction in the moist gaseous phase or in aqueous solution. This low temperature reaction forms the basis of a novel high vacuum method for estimating milligram quantities of hydrogen sulfide when in the presence of gases, such as carbon dioxide, whose volatilities are sufficiently similar to preclude the use of normal low-temperature vacuum fractionation methods.

Infrared Spectroscopy

On the Threshold of Sensitivity of an Infrared Adsorption Gas Analyzer with Gas Modulation. A. O. Sall. *Optics and Spectroscopy 6,* (Pub. by the Akad. Nauk SSSR, Trans. by Opt. Soc. of Am., Inc.) 247 (1959) Mar. (3 pp.)

Single flow absorption infrared gas analyzer is described in which the quantity of the component to be determined of the mixture being analyzed in the flow path varies periodically. The dependence has been investigated of the threshold sensitivity of such a gas analyzer on the threshold sensitivity of the radiation receiver being used, the length of the working chamber and the absorption coefficient of the component to be determined. A formula has been obtained to calculate the threshold response.

Mercaptans

Improved Separation in Gas Chromatography by Temperature Programming. Application to Mercaptans and Sulfides. J. H. Sullivan, J. T. Walsh and C. Merritt, Jr. *Anal. Chem. 31,* 1826 (1959) Nov. (4 pp.)

A method of nonlinear programming is described which provides adequate separations. Conventional gas chromatography equipment may be employed with only minor modifications. The separation of a mixture of 12 mercaptans, boiling range 35°-220° C, and a mixture of 11 sulfides, boiling range 37°-235° C, is described. All of these compounds, including isomeric as well as normal members of each series, are efficiently separated in 28 minutes on a 7-ft squalane column which is temperature programmed from 20°-150° C.

Olefins

Determination of Propadiene Traces in Propene. E. Busa, P. Manaresi and L. Motta. *Anal. Chem. 31,* 1910 (1959) Nov. (2 pp.)

Gas chromatographic technique is described for the determination of propadiene traces in rectified propene fractions from thermal cracking of petroleum. By the use of a silver nitrate-ethylene glycol column from which propadiene is eluted before propene, it is possible to obtain a complete separation of propadiene traces from propene present in large excess. This method enables the determination of propadiene traces up to about 5 ppm. With an enrichment technique it is possible to detect less than 1 ppm of propadiene.

Particle Size

Determination of Particle Size by β-Back-Scattering. P. Connor, W. H. Hardwick and B. J. Laundy. *J. Appl. Chem. 9,* 525 (1959) Oct. (7 pp.)

Cumulative method of particle size analysis is described wherein the mass deposited from an homogeneous suspension by gravitational or centrifugal force is determined by a β-back-scatter thickness measurement technique. The method is applicable to compounds having an effective atomic number greater than 16, and comparisons of results obtained by this and other methods for thoria, urania, zirconia and lithopone powders are given.

A Sedimentation Balance for Particle Size Analysis. L. Cohen. *Instrument Practice 13,* 1036 (1959) Oct. (5 pp.)

Description is given of the design and operation of the Gallenkamp liquid sedimentation balance for particle size measurement in the sub-sieve range. Special emphasis is given to the preparation of samples. Future development as a recording instrument is outlined.

Potentiometers

Calibration of Padded-Potentiometer Function Generators. G. A. Korn. *Instruments and Control Systems 32,* 1539 (1959) Oct. (2 pp.)

Calibration technique uses operational amplifiers to hold one tap of the padded potentiometer at a constant potential while the adjacent tap is being adjusted. Unique feature is that only two precision potentiometers are used.

Spectrography

Accuracy in Spectrochemical Analysis. A. Arrak and A. J. Mitteldorf. *Appl. Spectroscopy 13,* 85 (1959) Aug. (7 pp.)

Accuracy is one of the broad areas of spectrochemical analysis where improvement by an order of magnitude would result in vast new fields of application. Article discusses the subject under the topics of sampling, the source, electrodes, the spectograph, photometry and calculations. New techniques for reducing variables are discussed. These include optics for reducing the effects of arc wandering, the *Elpac* for reproducible packing of powders into electrodes, devices for mechanically traversing a flat sample during sparking, the Stallwood jet and enclosed arc chamber.

Flame Photometric Determination of Lead and Manganese in Gasoline. G. W. Smith and A. K. Palmby. *Anal. Chem. 31,* 1798 (1959) Nov. (5 pp.)

Rapid and accurate flame photometric methods have been developed for determining lead and manganese in gasolines. In each method, the sample is burned in an oxyhydrogen flame. In the lead method, base stock effects are eliminated by using an incremental addition of lead for calibration. In the manganese method, base stock effects are reduced sufficiently by diluting the sample at least twentyfold with isooctane. Lead naphthenate and tetraethyllead are equally satisfactory reference materials for determining tetraethyllead; manganese naphthenate is satisfactory for determining organomanganese additives. Burner fouling, a major source of error, is eliminated by periodically aspirating acetone through the burner. The determinations are accurate to about 2% of the amount present for lead, and to about 3% for manganese. Approximately 40 lead and 80 manganese determinations can be made per man-day.

13. BASIC SCIENCE

Acetylene

P-V-T Properties of Acetylene. G. A. Bottomley, C. G. Reeves and G. H. F. Seiflow. *J. Appl. Chem. 19,* 517 (1959) Oct. (2 pp.)

Results from a new precise determination of the PVT properties of pure acetylene are present in tubular form for the range 0-40° C and 0-2 atm.

Adsorption

The Adsorption of Some Gases on Evaporated Metal Films and on Oxidized Films of Nickel. J. L. Shereshefsky and B. R. Mazumder. *J. Phys. Chem. 63,* 1630 (1959) Oct. (9 pp.)

Low pressure adsorption isotherms at 76.8 and 90.2° K are reported for krypton, methane and ethane on copper and oriented nickel evaporated films, and on an oriented oxidized film of nickel. The krypton and methane isotherms on nickel oxide and the krypton isotherms on nickel follow the Langmuir equation. The methane isotherm at 76.8° K on nickel is s-shaped, the low pressure region following the Langmuir equation. The ethane isotherms on copper, nickel and nickel oxide are all s-shaped. The ethane isotherm on nickel oxide shows a first-orderphase change. The nature of the adsorbed phase, the variation of the calculated heat of adsorption is discussed from the point of view of the van der Waals two-dimensional equation, the entropy of adsorption and the effect of the polarizing field of the adsorbent on the van der Waals attraction. Proof is given for the orientation of ethane in the adsorbed phase, and a method for the preparation of oriented films of nickel oxide is described.

Adsorption Studies on Metals. VIII. Monofunctional Organic Molecules on Reduced and Oxide-Coated Nickel and Copper. Y-F. Yu, J. J. Chessick and A. C. Zettlemoyer. *J. Phys. Chem. 63,* 1626 (1959) Oct. (5 pp.)

Monolayer coverage, reversibilities and heats of adsorption of monofunctional organics were studied at 0-35° on reduced nickel and copper powders. More extensive and intensive chemisorption of 1-propanol, *n*-propylamine and benzene occurred on the electron-deficient d-metal, nickel, than on copper. Surface reaction developed in the case of *n*-butyraldehyde on nickel. Decreasing heats of adsorption with increasing coverage were usually found for chemisorption, but for propanol on nickel the heats of adsorption remain constant (explained by

a dissociative adsorption mechanism). Low heats of adsorption for benzene on nickel are explained on the basis of energy absorption needed to destroy the ring resonance. Comparisons were made with adsorption on thinly coated oxide films.

Fluid Flow

On Curved Shock Waves in Three-Dimensional Gas Flows. R. P. Kanwal. *Quart. Appl. Math. 16,* 361 (1959) Jan. (12 pp.) (From *Appl. Mech. Rev. 12,* 705 (1959) Oct.)

Author derives expressions for the gradients of velocity, pressure, density, entropy and vorticity behind a general three-dimensional curved shock wave in a uniform flow with a constant γ. Results are given in Cartesian tensorial notation. It is shown that the vorticity compoent normal to the shock surface is everywhere zero, and that the only physically significant shock surfaces through which the flow remains irrotational are the conical and plane shocks. Paper contains relatively little new information, although some known results have been rederived in more elegant and rigorous fashion.

L. Talbot, USA

On the Solution of the Laminar Boundary-Layer Equations. M. Epstein. *J. Aero/Space Sci. 26,* 58 (1959) Jan. (2 pp.) (From *Appl. Mech. Rev. 12,* 705 (1959) Oct.)

Author transforms Prandtl's boundary-layer equation into a nonlinear integral equation for the shearing function and solves this equation by iteration. He chooses the first approximation in such a way that it satisfies the boundary conditions and has the correct asymptotic behavior at infinity. Application to the shearing stress distribution on a circular cylinder and other examples shows good agreement with exact solutions.

K. Pohlhausen, USA

Heat Transfer

Compressible Turbulent Boundary Layers with Heat Transfer and Pressure Gradient in Flow Direction. A. Walz. *J. Research 63B, (Math. and Math. Phys.)* 53 (1959) July-Sept. (18 pp.)

Survey of approximation theories for compressible laminar and turbulent boundary layers with heat transfer at the wall and arbitrary pressure gradient in the flow direction shows that only a two-equation method has been used up to the present, although an infinite number of equations is available. A new derivation for the two infinite sytems of integral conditions based upon the partial differential equations for the velocity and temperature field is given. This two-equation method now available with preliminary evaluated universal integral terms has been applied to the study of the dependence of the friction coefficient on compressibility and heat transfer. Good agreement with experimental data has been found.

Heat Exchange Intensification in the Critical Region with the Aid of Ultrasound. A. P. Ornatsky and V. K. Scherbakov. *Teploenergetika,* 84 (1959) Jan. (Russian text.) (From *Appl. Mech. Rev. 12,* 718 (1959) Oct.)

Data are given on the effect of ultrasonic vibrations in the cooling liquid upon the first critical point of heat exchange for a large volume.

From authors' summary

Phase Equilibria

Applied Hydrocarbon Thermodynamics. Part 14. Integral Technique for Vapor-Liquid Equilibria in Petroleum Distillation Calculations. W. C. Edmister. *Petrol. Refiner 38,* 163 (1959) Oct. (8 pp.)

Equilibrium vaporization calculations for petroleum fractions are usually obtained by empirical methods, for which compositions are defined by analytical batch distillation. Similar calculations for multicomponent hydrocarbon mixtures are computed by theoretical methods for which compositions are defined by the number of moles or the mole fraction concentrations of a discrete set of components.

Heats of Mixing and Vapor-Liquid Equilibrium Calculations. B. C-Y. Lu. *Can. J. Chem. Eng. 37,* 193 (1959) Oct. (7 pp.)

In the literature, when the available integrated forms of the Gibbs-Duhem equation are employed for extrapolating vapor-liquid equilibrium data at isobaric conditions, the relative partial molal enthalpies at constant liquid compositions, L, are assumed either to be zero or to be independent of temperature. An investigation of the temperature effect on heats of mixing for non-ideal solutions reveals that these assumptions are invalid and that the quantity L varies linearly with temperature. Therefore the liquid activity coefficients at constant compositions should involve three temperature terms of the form $a + (b/T) + c \log T$ for extrapolating purposes. As a result, more general equations are proposed.

Heat Transfer

Vortex Tube with Flow Control Means. F. H. Green (assigned to the Garrett Corp.) U.S. 2,904,965 (1959) Sept. 22.

In a vortex tube for separating hot and cold gases from a mixture, improved efficiency is claimed for a design in which the outer hot tube is extended by adding a closed tubular chamber with a restricting connection at the end opposite the vortex inlet. This chamber stabilizes the helical flow of gases and allows the entire tube length to be utilized.

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